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ENERGY - A NEW OUTLOOK

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PREFACE

In late 1978 and again in late 1983, Voluntary Planning published two distinct examinations of the limited energy options available to Nova Scotia. These studies, published as "Energy Outlook 1990" and "Energy Update 1995", have been overtaken by the ever changing energy scene.

The period since the publication of "Energy Update 1995" has seen the termination of the National Energy Program of 1980 and the return to the private sector of the major responsibilities for the marketing of energy resources. The planned privatization of Petro Canada will complete the dismantling of controls, once thought essential, to return the petroleum industry to Canadian ownership.

Global energy consumption is on the rise, as populations expand and strive for better standards of living. It is becoming more and more apparent that we can no longer ignore the harm being done to the environment by our indiscriminate use of energy.

In the time that it has taken to prepare this report there has been growing public awareness and political concern for the possible effects of global warming associated with the increase in carbon dioxide and other greenhouse gases in the atmosphere. As a result, stringent regulations are being proposed to limit further increases in the greenhouse gases. These regulations are based on incomplete knowledge of the greenhouse effect, and the probable consequences for mankind. There is a clear need to support more extensive and ongoing research into these matters at provincial, national and international levels.

The requirement to price energy at its true cost (which includes the costs of environmental safeguards), the increased cost of oil on world markets because of the volatile situation in the Middle East, and the effects of various energy subsidies and taxes applied by many governments, make it impossible to forecast, with any degree of accuracy, either the cost or availability of future energy options. However, this report, compiled from the individual inputs of Voluntary Planning Energy Sector members, attempts to examine, in some detail, the various possible energy sources and to forecast which will likely be significant within a ten year time span.

Given Voluntary Planning's limited resources, this report was made possible only with the help extended by the Nova Scotia Department of Mines and Energy, the Nova Scotia Power Corporation and representatives of the Public Utilities Board.

This report is in three sections - Executive Summary, Recommendations and main text. The subject matter of the Executive Summary is set out in the same order as that in the main text.

TABLE OF CONTENTS

		Page
PREFACE		i
EXECUTIVE SUMMARY		xi
RECOMMENDATIONS		
1	**CHANGES IN THE WORLD ENERGY SITUATION**	**1**
1.1	Centrality of Oil	1
1.2	Energy Options	1
1.3	Policy Environment	4
1.4	Conclusion	5
2	**THE CANADIAN ENERGY SITUATION**	**7**
2.1	Overview	7
2.2	Effects of Free Trade on Energy	8
3	**THE NOVA SCOTIA SITUATION**	**11**
3.1	Overview	11
3.2	Present Sources of Energy	16
3.2.1	Coal	16
3.2.2	Petroleum	21
3.2.3	Wood Energy	22
3.2.4	Hydro	24
3.3	New Sources of Energy	24
3.3.1	Tidal	24
3.3.2	Nuclear	25
3.3.3	Offshore Petroleum	29
3.3.4	Emerging Techniques and Sources	33
3.4	Public Utilities Board	41
3.4.1	Purpose and Authority	41
3.4.2	Present Role and Function	41
3.4.3	Evaluation of Effectiveness	42
3.5	Nova Scotia Power Corporation	43
3.6	Conservation	46
3.7	Energy and the Environment	48
3.7.1	Air Pollution	49
3.7.2	Global Warming	49
3.7.3	Acid Rain	50

Appendix A - The Ozone Layer and the Greenhouse Effect
Appendix B - Energy Demand Forecast 1988 - 2005
Appendix C - Nova Scotia Power Corporation
Appendix D - Recommendations - Report of the Select Committee on Forestry
Appendix E - Conversion Factors
Appendix F - List of References

LIST OF TABLES IN TEXT

		Page
1.1	World Oil Demand, Distribution of Production and Oil Prices, Selected Years	2
1.2	World Crude Oil Reserves, Selected Years, 1975-1988	3
3.1	1989 Primary Energy Demand in Nova Scotia and Canada	13
3.2	Fuel Cost Comparisons	15
3.3	Nova Scotia Coal Production	17
3.4	Disposition of Nova Scotia Coal	18
3.5	Nuclear Reactors Worldwide	27

LIST OF FIGURES IN TEXT

		Page
3.1	Primary Energy Demand in Canada and Nova Scotia	12
3.2	Location of Significant Discoveries, Scotian Shelf	30
3.3	Signficant Oil Discoveries and Oil Shows, Offshore Nova Scotia	31
3.4	Major Gas Discoveries in Vicinity of Sable Island	32

LIST OF ABBREVIATIONS IN TEXT

The following abbreviations appear in the report. The full citation is used the first time the word appears in the Executive Summary, Recommendations and each chapter of the main text; thereafter, the abbreviation is used.

ATFs	alternative transportation fuels
CANMET	Canadian Centre for Mineral and Energy Technology
CBDC	Cape Breton Development Corporation
CFB	circulating fluidized bed
CNG	compressed natural gas
CO_2	carbon dioxide
CWF	coal-water-fuel
DHW	domestic hot water
FGD	fuel gas desulphurization
FTA	Free Trade Agreement
IGCC	integrated coal gasification combined cycle
LNG	liquified natural gas
NSDME	Nova Scotia Department of Mines and Energy
NSPC	Nova Scotia Power Corporation
NO_x	nitrogen oxide
OPEC	Organization of Petroleum Exporting Countries
PUB	Board of Commissioners of Public Utilities
PV	photovoltaic
SO_2	sulphur dioxide
TMP	thermal mechanical pulping

EXECUTIVE SUMMARY

1 Changes in the World Energy Situation

Developments in international oil markets played the pivotal role in world energy conditions in the 1980's, the key factor being the abrupt reduction in the price of oil in mid-decade which has severely eroded the economics of energy mega projects and has delivered a setback to the market prospects for new sources of energy. These developments have been accompanied by changes in the energy policy environment, notably in North America, which have seen a progressive restriction of government direct financial intervention in energy markets, together with increasing deregulation, and increasing policy concern about the environmental impacts of energy, and other industrial projects and activities.

The continued volatility of the political situation in the Organization of Petroleum Exporting Countries (OPEC), and the resultant impact on oil price behaviour, has exacerbated the market risk confronting energy project development. Future projects will need financing mechanisms for greater sharing of risk. Governments will continue to have a hefty financial involvement in energy projects in the years to come.

2 The Canadian Energy Situation

Canada continues to be a nation with one of the highest consumptions of energy per capita. The predominance of oil as a primary energy source has diminished in the last decade, while the use of natural gas, hydro, nuclear and renewable sources has increased. Continued low prices and the lack of strong government incentives have resulted in delays in bringing into production frontier oil and gas off the east coast of Canada and in the Arctic.

A moderating rate of growth in electrical demand combined with a greater move toward energy efficiency or demand side management options, will slow the need for construction of major new electric power generation capacity, although some construction to serve firm power markets in the eastern United States could occur.

The future of nuclear power remains uncertain in the face of public concern about environmental hazards from the presence of nuclear plants and the lack of publicly acceptable methods of disposing of radioactive waste. This suggests that new nuclear projects in Canada will proceed only in places where they are perceived to be the most viable energy alternative. Depressed world coal prices forecast to continue for the short term may constrain growth in coal production for electricity generation.

In the short term, Canada has a favourable energy situation; but solutions are needed to overcome the present lack of access to a secure supply of oil and gas for eastern Canada. This is of particular importance in the transportation sector with its heavy reliance on energy from fuels derived from imported oil.

In the longer term, it will be important that oil and gas exploration and development be revitalized, so that Canada's future needs can be satisfied from Canadian resources. Further research and development will be required to minimize the impact of man's use of energy on the environment.

The Free Trade Agreement (FTA) will encourage the flow of energy between Canada and the United States. Access to major energy markets in the northern United States can assist in realizing economies of scale to energy resource development in Canada, however, these increased exports may be at the expense of Canada importing environmental problems. Concerns regarding the greenhouse effect could favour tidal, nuclear and hydro energy sources thus encouraging new Canadian development.

3 The Nova Scotia Situation

3.1 Overview

For many years, the Atlantic provinces in general and Nova Scotia in particular, have sought to establish a strong and competitive economy. Progress has been made in mitigating the region's heavy dependence on a single energy source -- crude oil, but the Atlantic energy economy still remains less diversified and more vulnerable to oil supply disruptions than other parts of Canada. Although production potential exists, the region currently has no access to natural gas and must import all its oil.

A greater dependency on high-priced fossil fuels and limited economies of scale have caused electrical energy costs to be higher on average in the Atlantic provinces than in the rest of Canada, with Nova Scotia having the second highest cost after Prince Edward Island.

Provincial government policy has been successfully directed to reduced oil consumption in electrical generation by producing and utilizing indigenous coal resources. Although this action has achieved a saving of oil, it must be recognized that transportation, not power generation, remains the largest user of imported oil.

3.2 Present Sources of Energy

Coal

Coal remains the largest energy resource in Nova Scotia, with ample reserves to support increased production for domestic and export markets. In 1990, approximately 69% of the coal produced was used in the province, with 3% shipped elsewhere in Canada and 28% exported.

The future of the export trade for coal is dependent on achieving competitive pricing and acceptable quality. While Nova Scotia could address these factors through the use of new technologies, it is highly unlikely that international sales will increase significantly in view of the glut of higher-quality coal available on the market.

The largest producer of coal in Nova Scotia is the Cape Breton Development Corporation (CBDC). Its present mission statement reflects the ongoing interest in maintaining a balance between social and economic objectives for the coal mining industry. Previously there has been a reliance on the industry as a major source of employment. This reliance has in the past, and may in the future, make the closing of unprofitable operations slow and contentious. This could impede the objective of CBDC to rehabilitate and reorganize the coal mining industry on Cape Breton Island, to be economically viable.

The cost of the industry's capital equipment is currently borne by the federal government without recoveries through provincial funding or revenues, however, federal support is slated to be withdrawn by 1994. Since CBDC's goal is to become self-sufficient by that time, it is not certain how many mines will remain in operation, or the number of personnel that will be retained. If the Government of Nova Scotia decided to maintain the present levels of employment, it would become responsible for any subsidization required.

Petroleum

Nova Scotia depends, at present, on imported crude to meet all of its petroleum requirements. Energy supplied by petroleum products is utilized in four general areas, namely transportation, industrial, residential and commercial, with transportation being responsible for approximately 53% of the total consumption. Propane is used as a heating fuel for cooking and for both space and process heating, as well as having a few applications in the transportation sector.

Wood

Wood continues to be a significant source of Nova Scotia energy, currently supplying approximately 7% of end-use energy demand in the province.

Efficient wood energy systems and effective utilization of the province's wood and biomass resources have the potential to benefit Nova Scotia by increased employment/business opportunities in rural areas, displacement of imported fuel oils currently used for heating and electrical generation requirements, a reduction in total provincial sulphur emissions, and further diversification of the energy supply mix.

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Hydro

Hydro contributes 4.3% to the provinces total primary energy demand. The small additional amount of energy which could be made available from the few remaining undeveloped sites would not add significantly to the total provincial energy supply.

3.3 New Sources of Energy

Tidal

Tidal power is still at a demonstration and development level in Nova Scotia. There now exists a fairly complete understanding of the Fundy ecosystem and of the potential effects of tidal power development.

In order to make significant amounts of tidal power available when required, it must be "re-timed". Tidal power is a renewable resource with a potentially low environmental cost which will be available as an alternative at such time as it becomes a financially viable option in comparison with other energy sources.

Nuclear

The position of the provincial government regarding the use of nuclear power has been made clear with the passage of Bill No. 76 (1989) amending the Public Utilities Act, in which it was stated "The Nova Scotia Power Corporation (NSPC) shall not construct a generating plant that utilizes nuclear energy to produce electricity." In addition, the Nova Scotia moratorium on exploration for uranium has been extended for a further five years, to January 1995. Nevertheless, as we begin to learn the extent of environmental damage that accompanies fossil-fuelled power plants, the public perception of the risk associated with nuclear power generation may change.

Offshore Petroleum

Although both the Cohasset and Panuke fields are small by world offshore standards, these fields are now being actively developed, due to the high flow rates, and location in shallow, ice-free waters.

Production life of these fields is expected to be about six years, however, the discovery and development of other small oil pools, which are predicted to exist on trend with Cohasset and Panuke, could extend the project's life and enhance profitability.

Natural gas discoveries offshore of Nova Scotia face a number of hurdles before production can proceed. These include the price that can be obtained in the export market of the northeastern states and the royalties and taxes paid to the federal and provincial governments. Long-term projects are promising with the growing northeastern United States market and the requirement for gas which will ensue.

Emerging Techniques and Sources

Coal-Water-Fuel

CARBOGEL is the trade name for the product resulting from a process which converts solid coal into a coal-water-fuel mixture (CWF). CARBOGEL is a replacement for fuel oil in industrial and electrical utility generating station boilers. A CBDC pilot test program has determined the manufacturing process to be technically viable; however, additional combustion testing is required. The lack of competitiveness with the use of Bunker 'C' oil at present prices, suggests that CARBOGEL will not have a significant impact as a Nova Scotia energy source for major industrial or electrical generating station use in the next decade.

Fuel Cells

The successful development and use of the fuel cell in the Apollo Space Program has resulted in continuing international development and evaluation of low-cost versions more suitable for commercial applications. The fuel cell generates low-voltage DC electricity directly from a chemical reaction with a very high efficiency and produces useful by-products.

The capital costs associated with fuel cell installations are falling as development continues. The quiet operation, lack of environmental problems and efficiency maintained over a wide load range make it especially suitable to supply peak load demands with a minimum of transmission losses. There is potential for use in generating electrical power in remote locations not easily or economically accessible by transmission lines. It could also lead to the revival of the electric vehicle for urban transportation.

Integrated Coal Gasification Combined Cycle

In 1987 the Nova Scotia Department of Mines and Energy (NSDME) began an assessment of integrated coal gasification combined cycle (IGCC) technology for electrical generation. At that time, IGCC had been identified as a promising technology for addressing the environmental problems associated with coal utilization. Since 1987 NSDME has awarded several contracts in their

continuing evaluation of IGCC technology. The CBDC, NSPC and CANMET (Canadian Centre for Mineral and Energy Technology) have also been active participants in this assessment through separate contracts and more recently through projects funded under the NSDME/NSPC/CBDC Coal Research Agreement.

At this time, it is predicted that IGCC technology will be an option in Nova Scotia for power plants coming on-line by the turn of the century. Increasingly-stringent environmental guidelines will force coal users, coal producers and government to look for technologies that can meet both energy and environmental challenges of the future.

Methane

NSPC, CBDC and NSDME are undertaking a feasibility study into the use of methane collected from the Lingan and Phalen collieries as combustion air for the Lingan Plant. If proven feasible, the project would utilize a currently wasted energy resource, reduce the contribution to the greenhouse effect of methane currently released from the mines and reduce sulphur dioxide (SO_2), nitrogen oxide (NO_x), and carbon dioxide (CO_2) emissions from the Lingan Generating Station.

Solar Energy

Passive solar heat gains can supply a large percentage of the heating needs of almost any building designed and constructed to take advantage of the energy source. Active solar domestic hot water systems have become less expensive and easier to install. Photovoltaic (PV) technology continues to improve its conversion efficiency and reduce costs. PV systems are viable now in many remote locations but probably will not become competitive for electrical consumers with access to the NSPC grid.

The Scotia Synfuels Project

Bench-scale test work has confirmed the suitability of high-sulphur Nova Scotia coal for co-processing, and the overall operability of the process. Government incentives are essential to attract private sector participation.

Alternative Transportation Fuels

In the foreseeable future, concern over clean air (greenhouse effect, carcinogens, etc.) will likely be the primary motivating factor in alternative transportation fuels (ATFs) research, development and demonstration, adding to the importance of economic and energy - related factors. Current barriers to the use of ATFs include limited local supply, relatively high prices, safety concerns, vehicle conversion costs, maintenance and performance of converted vehicles, convenience and availability of fuelling facilities, and advances in conventional fuels technologies.

Energy-from-Waste

Energy-from-waste facilities which incinerate solid or liquid waste and produce either electrical or thermal energy or both have been operating in North America for many years. The financial viability of these facilities varies with factors such as price received for energy produced and tipping fees paid by those depositing waste. Under normal circumstances, where other options are available for waste disposal, life-cycle costs for energy-from-waste plants will be higher than other common methods of disposal, thus creating a need for a subsidy. The requirement for effective control of emissions from the combustion process is an additional element which impacts on the cost of energy-from-waste plants.

Wave Motion

Since the energy density in waves along the Nova Scotia coast is much less than that contained in the waves off the English or Irish coasts, little likelihood exists that the use of wave energy will be of any practical interest to the province in the foreseeable future.

Wind Energy

Internationally, the performance and reliability of larger wind turbines continues to improve, but the units are still cost effective only in regions with high electrical costs or poor distribution systems. Wind energy's impact on Nova Scotia's electrical supply capability is likely to remain very small for the foreseeable future.

3.4 Public Utilities Board

The Board of Commissioners of Public Utilities (PUB) is responsible for the regulation of all public utilities including service to provide electricity, telephone, water and the sale of gasoline.

In recent history, the function of the PUB has moved away from a Court of Law to that of a Board of Inquiry. As such, it provides a public forum for discussion on rates and regulations, as well as on management and administrative procedures.

The PUB serves a useful function as a Board of Inquiry and a Regulatory Agency and as such, must function independently.

3.5 Nova Scotia Power Corporation

NSPC is a regulated monopoly which supplies most of the electric power and energy used by the citizens of Nova Scotia.

The PUB has in the past and on an on-going basis, carried out detailed analysis of NSPC's activity and has come to the conclusion that quality of service and operating efficiency are satisfactory. It has indicated some concern about the level of reserves and the need for an interest coverage ratio greater than 1.0. It has directed NSPC to recover financial revenues in excess of expenses to meet this objective.

It is agreed that Nova Scotia coal at its present subsidized pricing is the most economic primary fuel supply for use in the generation of electricity within the province. The uncertain future for federal support and increased public concerns about the environmental impacts of coal mining and combustion suggest that this conclusion be reviewed on a regular basis.

Voluntary Planning accepts the need for higher cost technology to meet requirements of reduced SO_2 and NO_x and accepts that the installation of a circulating fluidized bed (CFB) generating plant at Point Aconi is a means of achieving this.

3.6 Conservation

Conservation can reduce in a cost effective manner the increase in energy demand created by economic expansion, population growth and improving standards of living. Energy-efficient technologies in all sectors can and will contribute, in the future, to reduced energy requirements. In many instances, the introduction of more energy-efficient manufacturing processes has had the added benefit of lowering the environmental impacts of the industries concerned, with a net benefit to the environment of the province. Occupant comfort in the residential sector and safety in transportation are also motivating factors in energy-related decisions.

Effective support from both federal and provincial governments is required for public education and information on means of realizing energy efficiency, together with costs and likely payback periods. Significant business opportunities exist to supply and/or install cost-effective equipment.

While the federal government has been making major reductions in funding designed to support energy efficiency programs, the Government of Nova Scotia has, on its own initiative, continued and expanded the Energy Analysis Program to assist industry in the identification and examination of the cost effectiveness of energy saving opportunities. In addition the Government has made available an energy advisory service which offers advice on energy-efficient housing and heating systems.

Conservation's main role is likely to be that of decreasing pressure for major capital expenditures for new electrical generating plants at a time when environmental issues are increasing capital needs.

3.7 Energy and the Environment

Man's use of energy can have a harmful effect on the environment. The rising demand for energy is causing concern that these harmful effects will increase, and may even result in irreversible changes on a global scale. The processes include acid rain, the greenhouse effect, and possibly ozone depletion. The problem arises primarily from the ways by which man transports fuels and produces energy in a useable form.

Urban air pollution is an increasing problem for cities. Reductions in air pollution have been achieved through a move from private car-based transportation to more efficient systems combining rail, subway and bus. A number of countries, including the United States, are adopting national standards to reduce air pollution from transportation which will result in benefits to Canada.

The increasing concern for the environmental changes that could result from global warming, and the recognition that CO_2 may play a major role, is likely to favour energy sources which do not release CO_2 to the atmosphere, of which nuclear and hydro are the only significant options at this time. These sources can have other environmental problems, however.

Acid rain has had a considerable effect on lakes and rivers and has been identified as a probable cause of stunted plant growth and diseased trees.

Increasing public awareness of the impact of man's use of energy on the environment is likely to continue and will pressure government to produce further legislative and other responses to minimize environmental effects, the cost of which will ultimately be borne by the public.

For Nova Scotia, the most immediate problems will centre on how to continue to favour the use of Nova Scotia coal as an energy source while meeting increasingly-stringent standards for waste emissions. These factors require continual study to determine if the increasing concerns are warranted.

The cutting back of rail services in the province has effectively reduced the available options to the use of road transport. It is important that the rail-bed and rights-of-way are not abandoned or destroyed without careful thought to future needs.

RECOMMENDATIONS

Based on this report and the resulting conclusions, Voluntary Planning recommends the following actions.

Free Trade Agreement

- Any written agreements for energy trade should preserve a pricing flexibility to cover the costs of meeting increasingly-stringent environmental regulatory requirements in the future.

Nova Scotia Overview

- Energy plans for the province of Nova Scotia should be based on utilizing a balanced mix of resources, and in the longer term must move towards increasing the utilization of renewable fuel sources. Increased funding should be allocated for research and development to ensure that the necessary technology will be available for these future changes.

- Existing initiatives to pool electrical power generation capacity within the Maritime provinces should be expanded to include Newfoundland and Labrador, where economically feasible.

- The stated policy of the Government of Nova Scotia that the Nova Scotia Power Corporation (NSPC) should purchase directly from private sector producers to broaden the base from which the provincial energy mix is derived, should continue provided that (a) the project does not require public subsidy; (b) the environmental impact resulting from the use of a given energy resource is acceptable now, and within the planning horizon; (c) it is financially viable to broaden the base from which the provincial energy mix is derived; and, (d) the price is competitive with other energy sources.

Coal

- In view of the need to utilize Nova Scotia coal and at the same time meet the need to minimize adverse environmental effects, the Government of Nova Scotia should continue to provide funding support for the development of clean coal technologies.

- Consideration needs to be given to the continued operation of those mines where unprofitable operations persist. There is support for such operations in the short term, provided that this social cost is being covered through government funding rather than by electrical consumers.

Petroleum

- In a crisis there may be problems in ensuring adequate provision of oil for Nova Scotia. To allow time to overcome these problems, the Government of Nova Scotia should ensure that a suitable regional stockpile is maintained.

Wood

- Recommendations of the Select Committee on Forestry - Woodchip and Biomass (Appendix D) should be implemented, except that funding assistance for demonstration projects should be restricted to new combustion technologies.

- Government programs should be continued to encourage and support the growth of wood energy installations and related activities by providing technical and information related resources, promoting conversion in public sector facilities, supporting research and development activities, and working to support and improve forestry management practices. The natural regeneration of wood should be aided by proper forestry management practices. In addition, the amount and distribution of biomass resources should be monitored on a continual basis. Subsidies or incentive support should be limited to covering start-up costs.

- Advantage should be taken to develop joint projects on wood energy utilization with Canadian federal agencies, and with appropriate organizations in the New England states, or other locations where similar situations exist.

Tidal

- Taking into account the inability of electricity markets to support the additional costs associated with retiming, no further action on tidal power development should be considered at this time.

Nuclear

- The Government of Nova Scotia should retain nuclear power as an option for future energy planning since (a) it is likely to be recognized eventually as an environmentally acceptable method of energy production; (b) coal may no longer be acceptable for both environmental and economic reasons; and, (c) it acts as an alternative when negotiating energy prices from other sources.

Offshore Petroleum

- While it is recognized that the development of offshore gas may require a large export component, the maximum opportunity should be retained to serve the needs of Nova Scotia and to add value to the export.

- Natural gas, when it becomes available in Nova Scotia, should be used in the long term to satisfy specialized energy demands including liquified natural gas (LNG) and compressed natural gas (CNG) for use in transportation and heating. While this market is developing, natural gas may also be used with coal for generating electricity, using an appropriate process which offers improved efficiencies and reduced environmental problems.

Emerging Techniques and Sources

Coal-Water-Fuel

The technical feasibility of utilizing coal-water-fuel (CWF) in small commercial or residential installations should be evaluated to provide an in-province fuel alternative to existing furnace oil based on imported crude.

Fuel Cells

There should be an ongoing evaluation of fuel cell technology development as a means of generating electricity from local coal with a minimum of environmental impact, and as a practical way of retiming tidal power.

Methane

Studies of ways in which methane vented from coal mining operations can be used as an energy resource should be continued and acted upon where appropriate.

Scotia Synfuels

General support is given to the concepts of the Scotia Synfuels project, but Voluntary Planning lacks sufficient information to justify recommending direct financial support to the Government of Nova Scotia, unless such support is justified by significant and credible private sector investment.

Energy from Waste

The Government of Nova Scotia should support the concept of using municipal solid waste as an energy resource provided that the environmental impact is no more than that associated with land fill disposal, and that the price paid for the energy produced is competitive.

Public Utilities Board

- There is support for the request of the Public Utilities Board (PUB) that NSPC work towards achieving a closer balance between residential and commercial/industrial cost recovery rates.

- It is recognized that there is a need for a public forum to review and inquire into utility rate applications. Every effort should be made to simplify the review process, to ensure that effective public input is achieved while minimizing the expense.

- The PUB should continue to function as an impartial Board of Inquiry, scrutinizing all capital expenditures of NSPC, however, the present limit of $5,000 above which PUB approval is required, should be increased to a more appropriate level for this corporation.

- Concerning the PUB's administration of the Gasoline and Fuel Oil Licensing Act, there are a number of product/market issues warranting consideration, such as limiting the number of retail outlets and legislative amendments to allow for self-service gas stations. Further studies should be carried out.

Nova Scotia Power Corporation

- The need for additional generating capacity should be accepted in light of the load forecasts made by NSPC and based on the accuracy of past demand forecasts.

- The price paid to private power producers for electricity should not exceed the avoided costs for NSPC.

- The value of conservation programs (such as Power Smart) is recognized in reducing the demand for energy in general, and electricity in particular. Support should be given to identifying and implementing new economically viable programs for this purpose.

- In reviewing the options available to NSPC, it is accepted that at this time the only viable option is to generate electricity within the province utilizing Nova Scotia coal as the primary fuel.

- To avoid significant waste disposal problems, development work should be commissioned to establish cost effective ways of using the waste products from circulating fluidized bed (CFB) combustion as a raw material for manufactured products.

- Efforts to develop external markets for electricity generated from Nova Scotia coal should continue provided there are social and economic benefits to the province and the local consumer of electricity, and that the environment can be adequately protected.

Conservation

- An effective and sustainable energy policy should adopt appropriate advances in technology at every stage of the energy cycle, to improve the means by which we find, process, transport and use energy.

- The Nova Scotia Department of Mines and Energy (NSDME) in cooperation with NSPC should identify and cost all significant approaches to energy efficiency and the conservation of energy, whether from electricity or other sources, and this information should be made available to the general public in a suitable form.

- The Government of Nova Scotia should continue to offer the Energy Analysis Program and advisory service, as well as develop conservation - related demonstration projects.

- In planning new thermal generating plants, every effort should be made to ensure maximum utilization of the energy released by combustion. In particular consideration should be given to the use of low temperature waste heat from cooling water to provide industrial or district heating.

Energy and the Environment

- Continual study is required to determine if the increasing concerns about the cause and severity of global warming are warranted.

- Efforts should continue to develop a comprehensive public transport system within the Halifax-Metro area, as a viable and less environmentally-taxing alternative to the private car.

- The Government of Nova Scotia should preserve the rail-bed and other rights-of-way against future public needs to establish alternatives to road transportation.

Energy - A New Outlook

1 Changes in the World Energy Situation

1.1 Centrality of Oil

As in the 1970's, developments in international oil markets played the pivotal role in world energy conditions in the 1980's. The key factor was the abrupt change in the price of oil in mid-decade.

After the Organization of Petroleum Exporting Countries (OPEC) pushed up the price of oil several fold in 1978-79, coincident with the political turmoil in Iran, the price weakened gradually in the first half of the 1980's. The deep 1981-82 recession in industrial economies exacerbated the decline in demand for oil triggered by the price responsiveness of demand, and OPEC's share of world oil, production dropped (Table 1.1). When oil prices plummeted in 1986, OPEC's cohesiveness and exercise of market power were severely tested. OPEC survived, and under the discipline of reduced production of oil, prices recovered, but on the threshold of the 1990's oil prices were still markedly lower than the peak attained ten years earlier.

The price of oil has a powerful impact on the international economy. Oil price behaviour affects inflation (general price level) expectations; oil is a major input in an industrial economy and affects price structures and economic performance; oil price behaviour impacts the utilization of alternative energy sources, and the research, development and commercial application of non-conventional sources of energy.

The sharply lower price of oil since 1985 has severely eroded the economics of energy megaprojects and has delivered a setback to the market prospects for new sources of energy. These developments have been accompanied by changes in the energy policy environment, notably in North America, which have seen a progressive restriction of government direct financial intervention in energy markets, together with increasing deregulation, and increasing policy concern about the environmental impacts of energy, and other industrial projects and activities.

1.2 Energy Options

The 1986 collapse in, and the continued relatively low price of oil reflects persistent excess supply conditions in oil (and natural gas). However, rising prices and increasing volumes of production and consumption towards the end of the decade indicate a progressive reduction in excess supply. In North America, pressure on reserves has emanated from lower prices for oil and gas and from the consequent reduction in exploration activity. The reduced pace of exploration was accompanied by a return to conventional geological environments, and by a virtual evaporation of exploration in high-cost offshore frontier regions. Meanwhile, OPEC, although reducing its production of crude, increased its share of world oil reserves in the late 1980's. (Table 1.2)

Table 1.1

World Oil Demand, Distribution of Production and Oil Prices, Selected Years

	1975	1980	1986
Demand [1] (million bbls./day)	44.5	49.1	45.8
Market Shares (%)			
OPEC	61.1	55.0	40.0
USA	22.5	20.8	22.5
North Sea	0.4	4.3	7.9
Canada	3.8	3.7	3.9
Other	12.2	16.2	25.7
Oil Prices (U.S. $/bbl.)			
Official [2]	10.46	29.38	28.00
Spot [2]	10.43	36.00	13.20
WTI [3]	11.16	37.38	16.44

[1] Non-communist countries

[2] Middle East light crude

[3] West Texas Intermediate posted price

Sources: National Energy Board, **Canadian Energy Supply and Demand, 1987-2005**, September 1988; **1988 Energy Statistics Sourcebook**.

Table 1.2

World Crude Oil Reserves, Selected Years, 1975 - 1988 (Percent)

	1975	1980	1985	1988
OPEC	74.3	71.8	71.3	82.5
United States	5.0	4.1	4.0	2.9
Mexico	1.4	6.8	7.0	6.0
United Kingdom	2.4	2.3	1.9	0.6
Canada	1.0	0.9	0.8	0.7
Communist Countries	15.6	13.3	11.6	9.2
Residual	0.3	0.8	3.4	A
Total	100.0	100.0	100.0	100.0
Total Reserves (Billions of barrels)	658.7	648.0	699.4	907.4

A - Negative residual: country and region sum exceeds total world in data source.

Source: Energy Mines and Resources Canada, **Energy Statistics Handbook**.

Coal has also experienced lingering excess supply conditions in international markets. Prices have declined substantially. In this context, the most recent contract between the Nova Scotia Power Corporation (NSPC) and the Cape Breton Development Corporation (CBDC) included a reduced price for coal delivered to thermal generating plants in Nova Scotia. This has helped moderate electricity price increases in the province.

Nuclear energy development has been restrained by the economics of lower prices for alternative sources of energy and by continued public perception about the environmental perils of radioactive emissions from power plant failure and from the disposition of fuel waste materials. Public apprehensions about the safety of nuclear power were heightened by the plant breakdowns at Three Mile Island (1979) and Chernobyl (1986).

In the early 1980's there was much optimism about the prospects for the utilization of new, alternative energy technologies, including: enhanced oil recovery; synthetic fuels production; biomass energy; harnessing solar, wind, and tidal power. Substantial research has been, and continues to be undertaken, but the sharply lower price of oil in the latter half of the 1980's has thwarted the commercial diffusion of these technologies. For instance, after at least a decade, the Lloydminister heavy oil upgrader project had not moved beyond the conceptual stage of development. Again, although the experimental 20-megawatt (MW) tidal power plant was commissioned in 1984, the prospect of large-scale tidal power development in Nova Scotia has faded.

1.3 Policy Environment

Canadian energy policy in the second half of the 1980's reflected a global trend in economic policy to loosen up on regulatory prescriptions, to reduce direct government intervention and to permit competitive market forces to determine prices and resource allocation. However, environmental protection has assumed a rejuvenated importance in Canadian policy since the publication of the Brundtland Commission Report (1987). A salient implication of this trend is that development projects will be increasingly scrutinized for their environmental impacts.

The federal and provincial governments have entered into an agreement to target reductions in sulphur dioxide (SO_2) emissions (acid rain). Intensified concern about the greenhouse effect has again raised questions about the use of fossil fuels for generating electric power, has pressed the urgency of developing more fuel-efficient vehicles, and, more generally, has stressed the importance of conservation.

At least three federal government policy initiatives have distinctly signalled the shift in policy stance reflecting global trends.

First, the new energy policy promulgated in 1985 completed the dismantling of the National Energy Program (1980). Canadian oil and natural gas prices would henceforth reflect world market prices.

Second, the Canada - U.S. Free Trade Agreement (FTA) contains provisions for liberalizing trading arrangements between the two countries in oil, gas, electric power and uranium. In essence, energy products are to be treated in the same manner as any traded good or service.

Third, as the 1980's drew to a close the federal government announced its intention to sell off Petro-Canada. This marks the end of the oil company as an instrument of national policy.

1.4 Conclusion

Oil's effectiveness as a political tool has been tempered by the emergence and persistence of excess supply in the 1980's. Oil prices now display the same volatile behaviour characteristic of commodities.

The continued volatility of the political situation in OPEC countries, and the resultant impact on oil price behaviour, has exacerbated the market risk confronting energy project development. During the long lead times required by such projects, economic conditions can change drastically between the decision to proceed with development and production start-up. Increased market risk will be augmented by higher project costs associated with environment policy requirements. Consequently, future energy projects will need financing mechanisms for greater sharing of risk. It should come as no surprise that governments will continue to have a hefty financial involvement in energy projects in the years to come.

2 The Canadian Energy Situation

2.1 Overview

Canada continues to be a nation with one of the highest consumptions of energy per capita. Although this energy demand is supported by a variety of domestic energy sources, these are not uniformly distributed. While western Canada has an excess of production over consumption, eastern Canada has a deficit particularly in oil. This deficit is met by importing foreign oil, in the absence of adequate access to western Canadian oil.

For Canada as a whole, the predominance of oil as a primary energy source has diminished in the last decade, while the use of natural gas, hydro, nuclear and renewable sources has increased. Use of oil is forecast to continue to decline in relative terms but not in absolute terms as the share of nuclear, coal and gas increase. In the short term, world oil prices are projected to remain depressed; a slow increase in prices is forecast in the longer term. Continued low prices and the lack of strong government incentives have resulted in delays in bringing into production frontier oil and gas off the east coast of Canada and in the Arctic.

Western gas is expected to continue as an important primary energy source with expanding sales into the USA as a result of the Free Trade Agreement (FTA), the increasing demand for a low cost fuel which is environmentally acceptable, and the end of the U.S. gas surplus (so-called gas bubble).

Energy from hydro, nuclear and renewable sources are next in order of significance in primary energy production in Canada. The proportion of energy from these sources has generally shown modest increase during the last decade. However, a moderating rate of growth in electrical demand combined with a greater move toward energy efficiency or demand side management options, will slow the need for construction of major new electric power generation capacity, although some construction to serve firm power markets in the eastern United States could occur. While nuclear power in Canada has a proven record of safe performance in those provinces in which it is utilized, the future of nuclear power remains uncertain in the face of public concern about environmental hazards from the presence of nuclear plants and the lack of publicly acceptable methods of disposing of radioactive waste. This suggests that new nuclear projects in Canada will proceed only in places where they are perceived to be the most viable energy alternative.

Nuclear power is a major energy source in Ontario, representing 34% of that province's installed capacity for 1989 [1]; with plans announced for construction of additional generating plants on the rationale that the all-inclusive costs are less than for fossil-generated electricity, and it is perceived to be easier on the environment.

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[1] Nuclear Sector Focus - Spring/Summer 1990, Atomic Energy of Canada Limited, Ottawa, p. F-3

It appears that a second plant will be built in New Brunswick with negotiations proceeding between the federal and provincial governments. The Nova Scotia Government has stated its opposition to nuclear power generation in order to support the coal industry. This has been safeguarded by the moratorium on uranium exploration and mining, recently extended to January 1995.

Canada's bituminous coal production has increased in the last two years with Nova Scotia showing the highest percentage increase. In Nova Scotia, coal is a significant fuel, substituting for oil, in electricity generation. Depressed world coal prices forecast to continue for the short term may place pressure on this program.

For Canada, the trend in end-use energy demand projected by the National Energy Board for the next decade shows oil retaining a diminishing lead as the main energy source supplying about one third of the total demand. Both natural gas and electricity are expected to increase in importance at the expense of oil during this period. These three energy commodities provide about 85% of the total end-use demand. Renewable energy sources, coal and natural gas liquids are projected to maintain their position filling the remaining 15%.

For the Atlantic region, the projected end-use energy demand shows oil continuing to account for over one-half the total demand, though with some loss to electricity and natural gas which is expected to increase in importance in the next couple of decades. These three energy commodities provide about 85% of the total end-use demand. Renewable and other energy sources are likely to continue to supply the remaining 15%.

Public concern increases about the contribution of traditional (combustion) methods of energy production to the greenhouse effect, acid rain and other environmental problems; this will be a significant factor in the choice and design of new energy plant and the updating of existing capacity.

In the short term, Canada has a favourable energy situation; but solutions are needed to overcome the present lack of access to a secure supply of oil and gas for eastern Canada. This is of particular importance in the transportation sector with its heavy reliance on energy from fuels derived from imported oil.

In the longer term, it will be important that oil and gas exploration and development be revitalized, so that Canada's future needs can be satisfied from Canadian resources. Further research and development will be required to minimize the impact of man's use of energy on the environment.

2.2 Effects of Free Trade on Energy

The FTA will reduce the remaining barriers to the flow of energy between Canada and the United States, including, among others, the following aspects:

a) taxes will not be levied against energy exports unless also applied to domestic consumption;

b) export restrictions will not be designed to disrupt normal channels of supply or to alter product mix;

c) existing and future incentives will still be allowed for oil and gas exploration and development;

d) licenses, fees or other measures cannot be used to charge higher prices for exports and imports unless for reasons of conservation of a renewable resource, national security or price controls. Except for national security, if such measures are applied, the exporter will not discriminate on price and will allow proportional access;

e) there will be a prohibition on minimum export and import price, except as permitted to enforce countervailing or antidumping orders; and

f) Canadian uranium no longer has to be processed for export to the U.S. and the U.S. will eliminate restrictions on the import of Canadian uranium.

Prior to the FTA, the National Energy Board faced a reduction in authority, and its new role has not yet been completely identified.

The FTA will likely increase north-south energy flow between suppliers and markets which are relatively close geographically; at the same time east-west energy flow within Canada may be expected to develop more slowly because of the geographic separation of suppliers and markets and the relatively small size of many markets.

Although the USA is a net importer of oil, gas and electricity from Canada, free trade could result in some increase in local imports of energy from the US by adjacent Canadian users where it is economically attractive. However, the overall trade is likely to remain an export of energy from Canada to the USA. Increased trade with the United States may also affect the existing pricing differential for oil products across Canada with a move to more competitive pricing.

On the positive side, the existence of major energy markets in the northern United States can assist in achieving economies of scale to energy resource development in Canada, with resultant economic gain. In the special case of electricity where maintaining an even demand is desirable, the American market may offer benefit if peak loads fall at different times of day or season. Canadian winter loading for heat and light may be balanced by USA summer loading for air conditioning.

Nevertheless, it must be recognized that energy is basically an input to the production of goods and services with added value. If this production takes place in the USA, the benefit in terms of the economy of this added value is lost to Canada.

Energy production is no longer regarded as benign; environmental impact is a matter of increasing concern so that increased energy exports to the USA may be at the expense of Canada importing the resultant environmental problems. Environmental considerations, particularly those concerning the greenhouse effect, could favour tidal, nuclear, and hydro energy sources and favour new Canadian development.

Nova Scotia at present has abundant energy reserves in the form of coal. World coal prices are depressed and the market is very competitive. At the same time it must be recognized that most Nova Scotia coal has potential environmental problems compared to other coals due to high sulphur content. There are considerable markets in the eastern United States for energy but coal is not a viable option on environmental grounds. The Bluenose Project attempts to address this by using Nova Scotia coal to generate electricity in Nova Scotia which would then be transmitted to the Boston area via submarine cable. This would avoid

environmental concerns about overland transmission corridors. It remains to be seen whether Nova Scotia's relative proximity to the Boston market and the abundance of Nova Scotia coal will be successful against competition from Hydro-Quebec based on James Bay hydro power.

With the continuing embargo on exploration in the eastern United States offshore, the potential to develop and import oil from the Scotian Shelf and Hibernia areas is an attractive alternative to reliance on importing overseas oil from the Middle East or South America with their political instabilities. At the same time, gas from the Canadian Atlantic offshore could be a viable alternative to bringing gas to the New England market by pipeline from the central United States or western Canada.

The eastern United States is thus a potential importer of oil and gas from the discoveries offshore Nova Scotia. Without access to these and other large markets it is doubtful if the limited demands of the Atlantic region could support offshore development, since shipment west to the larger markets of Montreal and central Canada would require a major pipeline and would face potential competition from western Canada and the United States.

The development by LASMO of the small Cohasset and Panuke oil field near Sable Island is based on offshore loading of the light crude oil into tankers for shipment to market. This market will be primarily in the United States.

In the longer term, this export to the USA could cause problems for supply conservation, if under the terms of the FTA the proportion of production which is retained for Canadian markets as compared to that part which is exported to the USA cannot be changed.

The large New England market for electricity is also a key factor in any plans to revive the Fundy Tidal Power Project. However, the Bluenose Project is likely to have priority from a Nova Scotia viewpoint because of the related job creation in the coal industry.

> **Voluntary Planning recommends that any written agreement for energy trade preserve a pricing flexibility to cover the costs of meeting increasingly-stringent environmental regulatory requirements in the future.**

In general, the proximity of the large energy-consuming market of the eastern United States is likely, initially, to be an advantage to Nova Scotia by offering expanded markets for coal, oil and gas production with the ability to bring into production resources which would not be feasible if supported only by the limited demand within the region.

But it must also be recognized that while it may be, in the short term, desirable for Nova Scotia and the other Atlantic provinces to encourage energy exports to the eastern United States, in the longer term the situation could change. Depleting reserves of oil, gas and coal may eventually make it desirable to conserve these resources for Canadian use. This may be difficult if there is a long-standing tradition of significant exports to the United States, which will have to be maintained under the terms of the FTA.

3 The Nova Scotia Situation

3.1 Nova Scotia Overview

For many years, the Atlantic provinces in general and Nova Scotia in particular have sought to establish a strong and competitive economy. Progress has been made in mitigating the region's heavy dependence on a single energy source -- crude oil, but the Atlantic energy economy still remains less diversified and more vulnerable to oil supply disruptions than other parts of Canada. (Figure 3.1, Table 3.1) Although production potential exists, the region currently has no access to natural gas and must import all its oil.

A greater dependency on high-priced fossil fuels and limited economies of scale have caused electrical energy costs to be higher on average in the Atlantic provinces than in the rest of Canada, with Nova Scotia having the second highest cost after Prince Edward Island.

Provincial government policy has been successfully directed to reduced oil consumption in electrical generation by producing and utilizing indigenous coal resources. Although this action has achieved a saving of oil, it must be recognized that transportation, not power generation, remains the largest user of imported oil.

The Atlantic provinces at present draw on a range of sources for electrical power which varies from province to province. Nova Scotia relies mostly on indigenous coal, with some oil and hydro generation. New Brunswick has a diverse mixture of nuclear, hydro, oil, coal and imported electricity from Quebec. Prince Edward Island buys substantial amounts of its electricity via submarine cable from New Brunswick while Newfoundland is supplied by oil, hydro-power and one small wood chip electrical generator. The majority of sources being high-cost contributes to an average electrical cost which is significantly higher than the rest of Canada.

Voluntary Planning recommends that existing initiatives to pool electrical power generation capacity within the Maritime provinces be expanded to include Newfoundland and Labrador, where economically feasible.

A physically and operationally balanced generation system would:

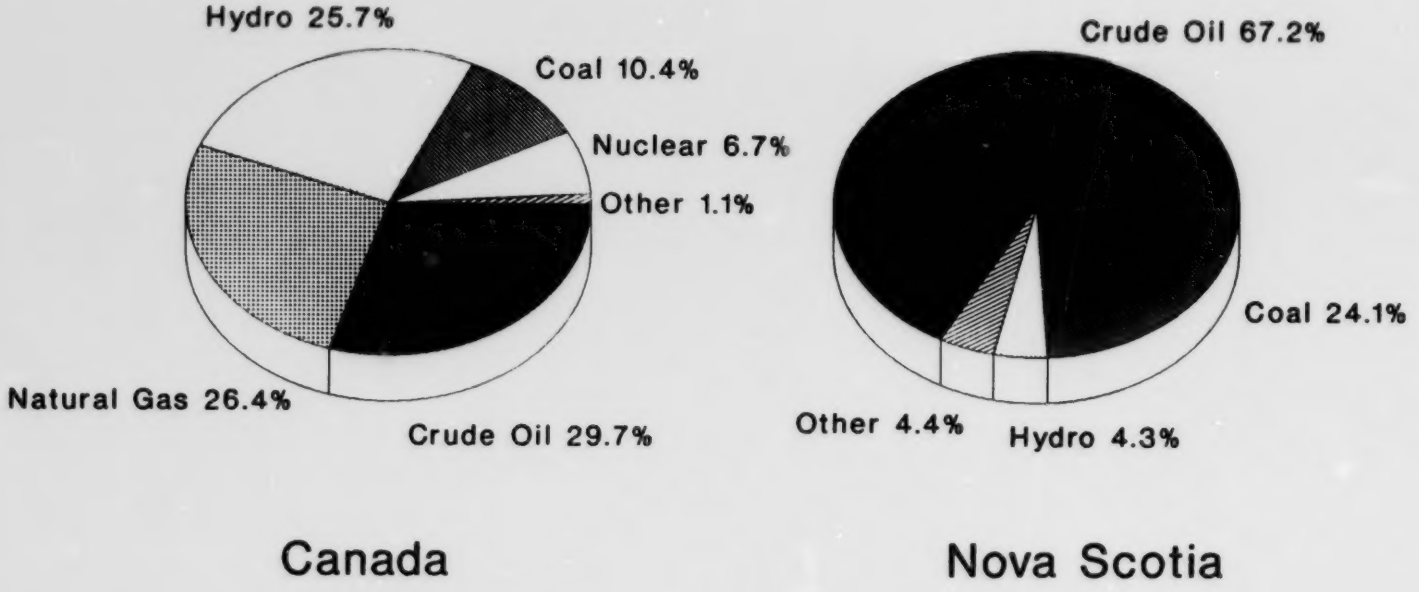
- improve load balances,
- offer new opportunities to achieve greater economies of scale,
- enhance access to hydro and nuclear power sources,
- likely result in the ability to raise capital at lower interest costs.

Voluntary Planning agrees with, and is supportive of the stated policy of the Government of Nova Scotia that the Nova Scotia Power Corporation (NSPC) should purchase directly from private sector producers to broaden the base from which the provincial energy mix is derived, provided that (a) the project does not require public subsidy; (b) the environmental impact resulting from the use of a given energy resource is acceptable now, and within the planning horizon; (c) it is financially viable to broaden the base from which the provincial energy mix is derived; and, (d) the price is competitive with other energy sources.

Figure 3.1

Primary Energy Demand in Canada and Nova Scotia

As a Percent of 1989 Total Energy Demand



Source: Nova Scotia Department of Mines and Energy

Table 3.1

1989 Primary Energy Demand in Nova Scotia and Canada
Relative Dependence on Imported Energy Supplies
(Percent of Total Energy Demand)

	Nova Scotia		Canada	
	Domestic	Imported	Domestic	Imported
Crude Oil	0.0	100.0	68.0	32.0
Natural Gas	-	-	98.5	1.5
Coal	100.0	0.0	64.9	35.1
Hydro	90.4	9.6	96.3	3.7
Nuclear	-	-	100.0	0.0
Others	100.0	0.0	100.0	0.0
All Fuels	30.2	69.8	85.5	14.5

Source: Nova Scotia Department of Mines and Energy

A Nova Scotia Department of Mines and Energy (NSDME) review of Nova Scotia's current energy mix and forecast of consumption demands is provided as Appendix "B". These charts indicate that the use of coal by all sectors will remain relatively constant to the year 2005, with the exception of the industrial/agriculture sector where decreased use in 1989 does not show a recovery to 1988 levels until the year 2000. The use of electricity by all relevant sectors shows a continual growth, averaging 3% over the period, while wood usage remains relatively constant. Forecasts indicate that the use of petroleum by all sectors, except residential, will continue to show a moderate rate of growth, averaging approximately 1.1% to the year 2005. The residential sector shows little growth over this period. Forecasts are also developed by NSPC. While based on different models, the results of both forecasts are virtually the same.

In terms of forecast accuracy, Appendix C-2 indicates that NSPC has tended to underestimate in the past ten years, but in comparison with other jurisdictions in Canada, there is less differential between projected and actual load growths. This would support the accuracy of NSPC's forecast for a 3.6% annual growth rate in demand.

It should be recognized that the forecast models favour gradually changing trends. The accuracy decreases the farther ahead is the forecast period. In particular, the models will not predict unusual events such as a closing of the Suez Canal or the breakdown of the OPEC oil price cartel.

> **Voluntary Planning recommends that energy plans for Nova Scotia be based on utilizing a balanced mix of resources, and, in the longer term, move towards increasing the utilization of renewable fuel sources. Voluntary Planning recommends that increased funding be allocated for research and development to ensure that the necessary technology will be available for these future changes.**

Table 3.2 presents comparisons of the cost of producing one million British Thermal Units of heat energy from different fuels.

NSDME offers information materials and services to each of the target audiences or sectors which it serves. For example, in the residential sector, a toll-free telephone advisory service [1], video loans, province-wide seminars and literature are provided. Activity sheets and resource materials are provided to educational audiences. Statistical information and information on energy resources, engineering and economics are also available.

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[1] Enerinfo toll free line - 1-424-5727 weekdays 8:30 a.m. to 4:30 p.m.

Table 3.2

Fuel Cost Comparisons
Province of Nova Scotia

Source	Unit	End-Use Efficiency	Price/ Unit	Cost per MM Btu
Oil	litres	70%	34.80¢	$13.57
Oil	litres	80%	34.80¢	$11.88
Oil	litres	83%	34.80¢	$11.45
Electricity	kW.h	100%	7.56¢	$22.17
Heat pump	kW.h	150%	7.56¢	$14.78
Propane	litres	65%	39.10¢	$24.83
Propane	litres	90%	39.10¢	$17.93
Wood	cord	50%	$100.00	$ 9.52
Wood	cord	50%	$160.00	$15.24
Coal	ton	55%	$120.00	$ 3.66

This table presents comparisons of the cost of producing one million British Thermal Units (MM Btu) of heat energy from different fuels. This system of comparing costs does not take into account the lower consumption offered by systems which can control temperature on a zoned or room-by-room basis. The actual costs for oil, wood, and propane systems may be somewhat higher due to losses up the chimney, stand-by losses, and duct losses. Efficiency varies for oil, wood and propane units. Heat pump comparison will vary depending on the type of backup heating used. Prices are as of March 18, 1991, GST included. Electricity prices are based on the use of electricity as a primary heating source. Propane prices vary according to the amount consumed. Prices also vary according to supplier and location in the province. As fuel costs change, the calculations can be done again using the constants provided for average seasonal efficiencies.

Source: Nova Scotia Department of Mines and Energy

3.2 Present Sources of Energy

3.2.1 Coal

Production: Coal remains the largest energy resource in Nova Scotia. With annual production of approximately 4.3 million tonnes (MT) of raw coal in 1990 (Table 3.3) and recoverable resources of 1.0 billion tonnes, there are ample reserves to support increased production for domestic and export markets. Currently, most coal produced in the province is used by NSPC to generate electricity (Table 3.4). The continuity of this demand must depend in part on the competitiveness of coal pricing, which, is itself, a product of both subsidy and productivity.

The following table indicates the percentage of the coal produced in Nova Scotia which was used in the province, shipped elsewhere in Canada and exported, in 1989 and 1990.

Disposition of N.S. Coal	1989	1990
	%	%
Nova Scotia	61	69
Other provinces	3	3
Exports	36	28

The largest producer of coal in Nova Scotia is the Cape Breton Development Corporation (CBDC). As stated in its corporate mission, it is:

> "in business to be a dependable supplier of quality coal and related energy products by operating a safe, commercially viable corporation which will provide a positive working environment through efficient and effective utilization of human, physical and technical resources. Supreme will be (its) regard for the protection of the physical environment, the interests of the shareholders, the employees, the community, and the long-term economic good of Cape Breton".

With the new Phalen mine reaching full production, CBDC is producing about 4.0 MT of run-of-mine coal, generating about 3.4 MT of saleable coal (1990). Of that, NSPC is taking about 2.1 MT, however, Westray could provide 0.7 MT when production commences, which will reduce CBDC's sales to NSPC significantly. The completion of Point Aconi will result in CBDC's production for the NSPC again reaching 2.1 MT.

There are no immediate plans for expansion of the CBDC coal mines. The earliest foreseeable expansion requirements would be for NSPC's Bluenose Project, which could necessitate the opening of another mine, most probably at Donkin.

The Westray coal mine in Pictou County, now under development, is scheduled for completion in the latter part of 1991, and will supply low-sulphur coal for unit No. 5 and the new NSPC generator No. 6 at Trenton.

TABLE 3.3

Nova Scotia Coal Production (Tonnes)

	1989	1990
Surface Output	409,067	291,606
Underground Output	2,972,272	4,035,557
Total Output	3,381,339	4,327,163
Opening Stockpile	305,149	57,608
Closing Stockpile	57,608	254,809
Adjustments	79,930	386,037
Shipped to Preparation Plant	1,773,017	2,467,477
Preparation Plant Waste	398,659	523,868
Saleable Production	3,310,151	3,992,081
Opening Inventory	581,398	237,742
Closing Inventory	237,742	442,080
Adjustments	(126,030)	(371,799)
Total Nova Scotia Coal Sales	3,527,777	3,415,944

Source: Nova Scotia Department of Mines and Energy

TABLE 3.4

Disposition of Nova Scotia Coal (Tonnes)

	1989	1990
Deliveries to Nova Scotia Power Corporation	2,108,277	2,287,263
Residential	40,008	32,733
Industrial	21,137	32,209
Total Disposition in Nova Scotia	2,169,422	2,352,205
To Other Provinces	94,019	116,155
Total Disposition in Canada	2,263,441	2,468,360
Exports	1,264,336	947,584
- Holland	67,171	0
- Belgium-Luxembourg	8,210	10,568
- Brazil	159,277	137,110
- Japan	279,965	26,450
- United States	167,252	30,504
- Sweden	134,424	102,197
- France	71	35
- West Germany	80,244	130,909
- Other	31,339	170,209
- Denmark	336,383	339,602
Total Disposition	3,527,777 [1]	3,415,944

[1] Overall sales of Nova Scotia coal exceed production of saleable coal in 1989 due to the depletion of coal stockpiles at the Cape Breton Development Corporation of over 500,000 tonnes.

Source: Nova Scotia Department of Mines and Energy

Future Markets

The future markets for Nova Scotia coal outside of the province are influenced by several factors:

a) the high ash content and high sulphur content of some Nova Scotia coal which restricts its potential application;

b) the difficulties of expanding markets because of handling costs/capital costs of infrastructure;

c) competition among producing nations, many of which are overproducing, leaving excess quantities to be disposed of;

d) the need to meet increasingly stringent emission regulations governing coal use; and,

e) the Canadian dollar exchange rate which impacts revenues, since coal is usually sold on the export market in U.S. dollars.

While Nova Scotia could address some of these factors through the use of new technologies, it is highly unlikely that international sales will increase significantly in view of the glut of higher-quality coal available on the market.

Increased use of coal as an end-use energy source within the province is also restricted by transportation and storage difficulties, as well as environmental concerns. A small amount of Nova Scotia coal is used for residential and industrial heating.

Clean Coal Technologies

The basic attraction of Nova Scotia coal remains its local availability and great abundance. The biggest obstacle to expansion of coal-fired power generation is the cost of environmental protection. Clean coal technology strives to use coal in an environmentally and economically acceptable manner.

> **In view of the need to utilize Nova Scotia coal and at the same time meet the need to minimize adverse environmental effects, Voluntary Planning recommends that the Government of Nova Scotia continue to provide funding support for the development of clean coal technologies.**

Three major groups of clean coal technologies may become commercially viable during the coming decade: fuel upgrading; sulphur dioxide (SO_2) and nitrogen oxide (NO_x) emissions control; and advanced combustion/gasification.

Fuel Upgrading: Pre-combustion coal treatment improves the general quality of the fuel and removes some of the sulphur. Such technologies have significant potential for lowering the costs of reducing SO_2 emissions when used in conjunction with other, lower cost, moderately effective control technologies applied during or after combustion. Technologies for fuel upgrading include physical, chemical and biological coal cleaning; coal water mixtures; coal liquefaction; coprocessing of coal and heavy oil; and other processes that upgrade the quality of coal.

Emissions Control: Technologies related to SO_2 and NO_x emissions control are being improved by a trend toward system simplification and better control of process chemistry. Improvements to flue gas desulphurization (FGD) ("scrubbers") combine much higher reliability with lower cost and lower water requirements than conventional FGD units. Some processes produce marketable waste products (gypsum).

The least expensive way to reduce NO_x emissions from a power plant is through combustion modification. This approach involves the redesign of burners or the rearrangement of fuel-air flow through a furnace to reduce flame temperature and thus limit oxidation of nitrogen.

Advanced Combustion and Gasification: Over the longer term, environmental protection can be achieved most efficiently by developing advanced combustion and gasification technologies that have built-in emissions control. Advanced technologies under development address not only acid rain but ozone, solid waste and global warming issues as well. Clean coal technologies will use less water for scrubbing, produce lower quantities of waste products and more reusable by products, and through their greater efficiency contribute less carbon dioxide to the atmosphere, than current commercial practices which utilize coal.

In addition to generating electricity, coal will probably be increasingly used as a raw material for the production of industrial and chemical feedstocks and transportation fuels. Clean coal technology means developing systems that extract in a commercially competitive manner the greatest possible value from coal, while producing virtually no wastes of any kind.

Other Considerations

The present mission statement of the CBDC (pg. 16) reflects the ongoing interest in maintaining a balance between social and economic objectives for the coal mining industry. Previously there has been a reliance on the industry as a major source of employment. This reliance has in the past, and may in the future, make the closing of unprofitable operations slow and contentious. This could impede the objective of CBDC to rehabilitate and reorganize the coal mining industry on Cape Breton island, to be more economically viable.

The cost of the industry's capital equipment is currently borne by the federal government without recoveries through provincial funding or revenues, however, federal support is slated to be withdrawn by 1994. Since CBDC's goal is to become self-sufficient by that time, it is not certain how many mines will remain in operation, or the number of personnel that will be retained. If the province decided to maintain the present levels of employment, it would become responsible for any subsidization required. Voluntary Planning is of the opinion that this course of action could not be supported.

The previous Voluntary Planning report (1983) envisaged the introduction of new technologies as a way of expanding market opportunities for the CBDC. The economic viability of gasification, liquefaction and Carbogel has not yet been proven; therefore NSPC is likely to remain a major CBDC customer for the foreseeable future.

A review of past CBDC Annual Reports indicates that, since its inception in 1968, it has not been able to make a profit on its total coal sales and the cost per tonne does not allow return on investment.

The 1988-89 Annual Report indicates that the rate of absenteeism continues to be unacceptable, which has led to extra costs associated with the overtime necessary to maintain output.

Consideration needs to be given to the continued operation of those mines where unprofitable operations persist. Voluntary Planning supports such operations, in the short term, provided that this social cost is being covered through government funding rather than by electrical consumers.

3.2.2 Petroleum

Nova Scotia depends, at present, on imported crude to meet all of its petroleum requirements. The province being a very small customer, in the international context, has no control over the price it pays for crude nor its availability. Of special concern to Nova Scotia, and indeed the Atlantic region as a whole, is the possibility of a rejuvenated Organization of Petroleum Exporting Countries (OPEC) cartel increasing prices and causing supply dislocations.

It should be noted however, that circumstances have changed since the early 1970's. We are no longer heavily dependent on any one source of supply, and non-OPEC countries supply a larger proportion of the world supply. The major concern is that the political, economic and strategic influences affecting the Middle East supplies of light crude are difficult to assess.

Voluntary Planning recognizes that in a crisis there may be problems in ensuring adequate provision of oil for Nova Scotia. To allow time to overcome these problems, it is recommended that the Government of Nova Scotia ensure a suitable regional stockpile is maintained.

End-use energy supplied by petroleum products is utilized in four general areas, namely, transportation, industrial, residential and commercial, with transportation being responsible for approximately 53% of the total consumption. Energy demand forecasts presented in Appendix B include the amount of petroleum products used by each sector. These forecasts indicate that the use of petroleum by all sectors, except residential, will continue to show a moderate rate of growth, averaging approximately 1.3% to the year 2005. The residential sector shows little growth over this period.

Propane is used as a heating fuel for cooking and for both space and process heating. A total of approximately 113 million litres is used annually in Nova Scotia. Almost 43% of this amount is used in the commercial and institutional sectors. The next largest user is the industrial sector at about 30%. Almost 23% is consumed in the residential sector. Approximately 4 million litres are used annually in transportation, 4% of total use.[1]

3.2.3 Wood Energy

Wood has been and continues to be a significant source of Nova Scotia energy, supplying approximately 7% of end-use energy demand in the province. In non-electrical, non-transportation applications, the potential is 25-30% of the end-use heating energy for industrial and commercial use only.

Nova Scotia has made progress in evaluating the use of wood as an energy resource. Government and the private sector have successfully worked together to install demonstration projects at locations such as Britex Limited, Gordon's Greenhouses, and the Nova Scotia Agricultural College.

It is generally recognized that efficient wood energy systems and effective utilization of the province's wood and biomass resources have the potential to benefit Nova Scotia by: increased employment and the generation of new business opportunities in rural areas; displacement of imported fuel oils currently used for heating and electrical generation requirements; further diversification of the energy supply mix, increasing stability through reduced dependence on non-renewable resources; and, a reduction in total provincial SO_2 emissions.

Voluntary Planning has reviewed the Report of the Select Committee on Forestry - Woodchip and Biomass, House of Assembly, May, 1987 and found it to be a comprehensive study of the possible use of wood and biomass as an indigenous source within the province of Nova Scotia. The recommendations, as outlined in Appendix D, should be implemented except that the funding assistance for demonstration projects should be restricted to new combustion technologies. In Voluntary Planning's opinion, sufficient trial projects have already been carried out for conventional systems.

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[1] Department of Mines and Energy, April 8, 1990

Inadequate forest management practices, disease, and other natural problems have significantly affected the potential long-term supply of wood that is available for the established lumber and pulp and paper industries, and also for use as fuel. The equivalent of approximately one million bone dry tonnes of unused forest residue is potentially available on an annual basis from existing forest harvesting and wood product manufacturing operations [1]. Debate continues on the desirability of extracting waste biomass from the forest floor for energy application, since a certain amount of this material is required to sustain renewal.

Wood chips seem to be the most feasible fuel from forest residue, with a potential market among industries and institutions, for use in hot-water or steam generators. The major barriers to the increased use of wood chips are the absence of a fuel supply infrastructure, the high costs involved in the installation of combustion systems, and the environmental effects of removing forest residue. Other factors to be addressed are the demands on the road system, the scattered geographic distribution of the supply together with the multiplicity of ownership. This will require the administration of a coordinated approach to transportation and marketing, and the need for an assured economic supply of quality woodchips. While some subsidy or incentive support may be required to cover start-up costs, the use of continued subsidies to encourage development or sustain utilization should not be supported, as this encourages inefficient use of a resource used by a variety of different industries.

Voluntary Planning recommends that government programs be continued to encourage and support the growth of wood energy installations and related activities by providing technical and information related resources, promoting conversion in public sector facilities, supporting research and development activities, and working to support and improve forestry management practices. The natural regeneration of wood should be aided by proper forestry management practices. In addition, the amount and distribution of biomass resources should be monitored on a continual basis. Subsidies or incentive support should be limited to covering start-up costs.

Wood energy utilization in the United States and Sweden was reviewed by the Select Committee on Forestry for its afore-mentioned report, and its recommendations should be used in formulating policy for Nova Scotia. It must be recognized, however, that in this province, conditions may differ and require alternate solutions.

Voluntary Planning recommends that advantage be taken to develop joint projects with Canadian federal agencies, and with appropriate organizations in the New England States, or other locations where similar situations exist for wood energy utilization.

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[1] Energy Plan 1985 - A Discussion Document, Nova Scotia Department of Mines and Energy, May, 1986, pg. 59

Wood energy assists in providing a mix of energy sources in the province. This has the potential in the longer term to lower the cost of energy and to maximize overall net economic benefits to Nova Scotia.

3.2.4 Hydro

The shock of rising petroleum prices in 1973 gave impetus to the development of the remaining untapped economic sources of hydro in the province. The subsequent construction of the Wreck Cove Station consisting of two (2) 110 - megawatt (MW) units, together with those at Gisbourne, Fourth Lake, Fall River and Bloody Creek completed the program. Those developments had the effect of raising the contribution of hydro to 4.3% of the province's total overall 1989 primary energy demand.

Assessment of the few remaining undeveloped potential hydro sites has concluded that only a relatively small amount of energy could be made available. This contribution, which would be less than 1% of overall energy consumption, would be difficult to realize without carrying out environmentally unacceptable construction.

In view of the above, it is concluded that small scale hydro cannot add any significant quantity to the Nova Scotia energy supply and deserves a low priority.

3.3 New Sources of Energy

3.3.1 Tidal Power

Numerous studies, undertaken in many parts of the world, have led to a good understanding of the potential for tidal power development. Nevertheless, only three tidal projects have been completed, a major one in France and demonstration projects in the Soviet Union and Canada.

Canada's first tidal power plant, completed at Annapolis Royal in 1984, makes use of a 20 MW straight-flow turbine and as a demonstration project has increased the technical viability of a full-scale tidal installation.

Previous studies in the Atlantic provinces had identified two potential sites worthy of detailed examination namely A8 in Cumberland Basin and B9 in Minas Basin. The annual output, with allowances for transmission losses, was projected to be 3,307 GW.h for Site A8, compared with 13,780 GW.h for Site B9. Although much preliminary work had been completed by 1984, much remains to be done including detailed design and cost estimates, environmental assessment, rights-of-way for transmission lines, and conditional agreements relating to financing and sale of output.

As a result of continuing studies, there now exists a fairly complete understanding of the Fundy ecosystem and of the potential effects of tidal power development. These include the effects of larger tides in the lower Fundy and Gulf of Maine, potential effects on the Gulf of Maine fishing and potential effects on fish due to tidal plant operation.

Experience at the Annapolis Tidal Generating Station has indicated that mortality imposed by the turbines on some species of fish has been higher than originally predicted. Consequently, an effective means for the mitigation of fish mortality would have to be provided for any large-scale tidal power generating stations.

Tidal power, because of its very nature, produces power in time with the tides, not necessarily when desired. In order to make significant amounts of tidal power available when required, it must be "retimed" which may be accomplished in several ways, of which the most economically attractive is the coordinated operation of hydro plants.

Although retiming by means of existing hydro is the preferred method, it cannot be carried out in the Maritimes since hydro installations of the necessary size do not exist. Quebec would seem to offer the only possibility in this regard, but approaches made to that province have been unsuccessful.

> **Voluntary Planning, taking into account the inability of electricity markets to support the additional costs associated with retiming, recommends that no further action on tidal power development be considered at this time.**

The Severn Barrage project has been the subject of serious study in England for the past several years; however, with the projected costs of power from the project estimated to be more than twice that of power provided by coal-fired stations or pressurized-water nuclear reactors, the project is unlikely to proceed.

Tidal power is a renewable resource with a potentially low environmental cost which will be available as an alternative at such time as it becomes a financially-viable option in comparison with other energy sources.

3.3.2 Nuclear Power

General

Since Voluntary Planning's last report, the controversy surrounding the use of nuclear power has become even more intense. The provincial government has made its position abundantly clear with the passage of Bill No. 76 (1989) amending the Public Utilities Act, in which it was stated "The Nova Scotia Power Corporation shall not construct a generating plant that utilizes nuclear energy to produce electricity." In addition, the Nova Scotia moratorium on exploration for uranium has been extended for a further five years, to January 1995.

Those who object to the use of nuclear energy have used many arguments to support their position. Nuclear arms proliferation, the possibility of serious nuclear accidents and the problem of permanent disposal of nuclear waste among the most serious considered. In addition, many claim that nuclear power is uneconomical, is not socially acceptable and is unnecessary.

Those who support the use of nuclear power argue their position with equal vigour insisting that it is cleaner and safer than other practical large-scale sources of electricity.

A balanced examination of Canada's experiences to date with nuclear generation was made by Voluntary Planning. The following resume of the present status is offered.

The Canadian Experience

The commercial prototype of the CANDU reactor was developed over the first two decades of the existence of the Canadian Nuclear Industry. This 200 MW reactor was later built at Douglas Point on Lake Huron. In 1989, eighteen utility reactors were in operation in Canada with four more under construction. Excluding three smaller prototype reactors in India and Pakistan, two full-size commercial CANDU reactors are operating abroad, one in Korea and one in Argentina. Korea is now considering using Canadian "slowpoke" technology for residential heating. The CANDU has a record of safe operation particularly when compared with other types of nuclear reactors.

The amount of power produced by reactors worldwide, and the number of units both operational and under construction, is shown in Table 3.5.

Atomic Energy of Canada Limited reported that the cost of nuclear produced electricity in 1989 in Ontario was 3.4 cents per kilowatt hour (kW.h) as compared to the cost of fossil-fired electricity mostly coal of 3.7 cents per kW.h. In 1988, CANDU reactors produced 65.26 billion kW.h so that the citizens of Ontario saved $195 million dollars in 1989 by using nuclear, rather than coal-produced electricity[1].

From Ontario's experience, the production of nuclear electricity is today a mature and viable technology, provided that the cost of safe decommissioning and disposal of radioactive materials, and concerns with health hazards associated with long-term exposure to low level radiation, are addressed.

With ever-decreasing oil reserves, the global production of the large amounts of electrical energy that will be demanded by an ever-growing world population can be provided only from three sources: namely, nuclear, hydro and fossil fuels. Hydro, since it can be produced only in limited geographical areas, will not be further examined in this context.

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[1] Nuclear Sector Focus - Spring/Summer 1990, Atomic Energy of Canada Limited, Ottawa, p. G-11, 12

Table 3.5

Nuclear Reactors Worldwide

	Reactors In Operation	Electricity Generated (MWe)	Percentage of Electricity Generation	Reactors Under Construction
NORTH AND CENTRAL AMERICA				
Canada	18	12,185	15.6	4
Cuba	0	0	0	2
Mexico	1	654	-	1
U.S.	110	98,331	19.1	4
SOUTH AMERICA				
Argentina	2	935	11.4	1
Brazil	1	626	.7	1
EUROPE				
Belgium	7	5,500	60.8	0
Bulgaria	5	2,585	32.9	2
Czechoslovakia	8	3,264	27.6	8
East Germany	6	2,102	10.9	5
Finland	4	2,310	35.4	0
France	55	52,588	74.6	9
Hungary	4	1,645	49.8	0
Italy	2	1,120	-	0
Netherlands	2	508	5.4	0
Romania	0	0	0	5
Spain	10	7,544	38.4	0
Sweden	12	9,817	45.1	0
Switzerland	5	2,952	41.6	0
U.K.	39	11,242	21.7	1
West Germany	24	22,716	34.3	1
Yugoslavia	1	632	5.9	0
ASIA				
China	0	0	0	3
India	7	1,374	1.6	7
Iran	0	0	0	2
Japan	39	29,300	27.8	12
Pakistan	1	125	.2	0
South Korea	9	7,220	50.2	2
Taiwan	6	4,924	35.2	0
U.S.S.R.	46	34,230	12.3	26
AFRICA				
South Africa	2	1,842	7.4	0
TOTALS	426	318,271	-	96

Note: Amount of power produced by reactors worldwide is shown above in megawatts electric, along with the percentage of electricity each one provides. In the last column the reactors under construction as of December 31, 1989, are given.

Source: International Atomic Energy Agency, Vienna

Carbon dioxide (CO_2) from the burning of fossil fuels contributes to the greenhouse effect which may result in accelerated and unacceptable climate changes. World opinion increasingly favours reducing this risk, so that there will be increasing pressure to minimize the burning of fossil fuels. A nuclear power plant develops no CO_2 and may represent the best long-term option to reduce CO_2 emissions to the atmosphere.

In addition, the burning of fossil fuels gives rise to other undesirable emissions which have had a devastating effect on the environment. Acid rain, caused by sulphur oxides and nitrogen oxides has caused wide spread damage to lakes and forests in North America which is still spreading. Fortunately, these emissions may be reduced by the use of scrubbers on traditional fossil-fired plants or by employing fluidized bed combustion. However, their use entails a high cost and exchanges the air problem for one of dealing with solid waste.

An additional concern is the problem of the safe disposal of spent nuclear fuel. This problem is still not completely solved, but much of the spent fuel should be considered as a resource that will be needed in the future.

The development of future fusion processes may offer an acceptable alternative to current nuclear technology, a moratorium on fossil-fuelled electrical power stations and an abundant supply of electrical energy for this planet's ever-increasing population.

Conclusion

Many environmental problems caused by humans arise directly or indirectly from the production and use of energy, but, we do not yet have any suitable methods to compare the relative impacts of different energy production technologies. Until the last decade, there was a general perception that while energy from fossil fuels gave rise to some air, water, and land pollution, the technology was, nevertheless, relatively benign compared to nuclear energy. The perception is now under examination; there is mounting evidence to suggest for example, that fossil-fuelled power plants are a major contributor to the greenhouse effect. The public is generally aware that energy production has some impacts on the natural environment, and some of these are within our ability to control. At present the means do not exist to compare the relative risk of a serious accident in a nuclear power plant to a fossil-fuelled power plant contribution to the greenhouse effect.

It seems likely the near future will see increased public interest in, and consequent expanded efforts to evaluate, the environmental and health impacts of available energy technologies. That evaluation could change the public perception of the risk associated with nuclear power generation.

It is recommended that the Government of Nova Scotia retain nuclear power as an option for future energy planning since (a) it is likely to be recognized eventually as an environmentally acceptable method of energy production; (b) coal may no longer be acceptable for both environmental and economic reasons; and, (c) it acts as an alternative when negotiating energy prices from other sources.

3.3.3 Offshore Petroleum

The petroleum industry has been actively exploring off Nova Scotia since 1959, at which time Mobil Oil drilled the first well on Sable Island. To date, 125 wells have been completed offshore Nova Scotia, with 22 being declared significant oil or gas discoveries. (Figure 3.2) These include the Cohasset and Panuke oil fields.

Exploration activity was at a high in the early 1970's, but declined later in the decade. Activity increased somewhat in the early 1980's, with Mobil's discovery of Venture, the Petroleum Incentive Program (PIP) grants and the Canada-Nova Scotia Offshore Petroleum Resources Accord. Drilling activity declined in the mid 1980's; in 1988 only one well was drilled. This decline was a result of a number of factors including low world oil prices, termination of PIP grants and high front-end development costs of offshore gas production. Drilling resumed in early 1991 in conjunction with the Cohasset and Panuke fields.

Oil Development

The Cohasset field drilled by Petro-Canada Inc. and the Panuke field drilled by Shell Canada Ltd. both gave indications of high flow rates. Although both Cohasset and Panuke are small by world offshore standards, these fields are now being actively developed, due to the high flow rates, and location in shallow, ice-free waters.

LASMO Nova Scotia Limited and Nova Scotia Resources (Ventures) Limited have finalized their plans to exploit the Cohasset and Panuke fields, and contracts have been awarded. The proximity to major refineries along North America will ensure a viable market for their products. Production life is expected to be about six years. However, the discovery and development of other small oilpools, which are predicted to exist on trend with Cohasset and Panuke, could extend the project's life and enhance profitability. (Figure 3.3)

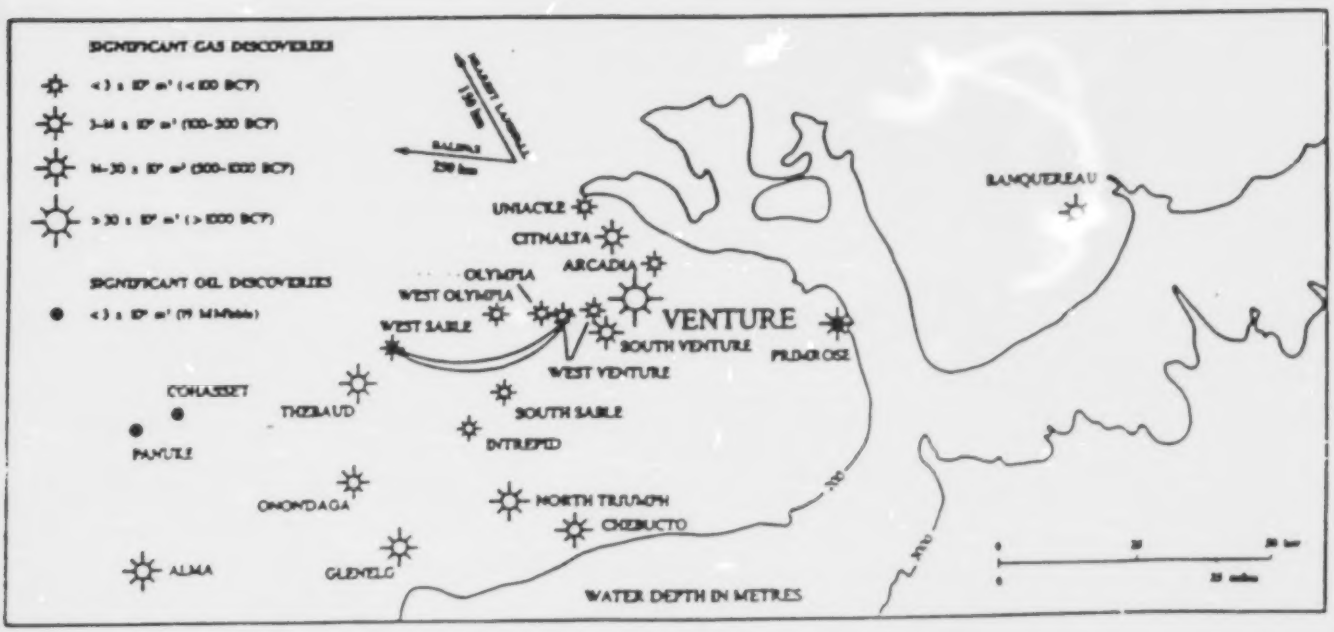
Natural Gas

Although natural gas has been found offshore of Nova Scotia in what is considered to be commercial quantities, many hurdles must be overcome before production can proceed.

During the 1980's six significant gas discoveries were made, three, Venture, South Venture and Thebaud by Mobil Oil Canada and partners and three further, Glenelg, North Triumph and Alma by Shell Canada (Figure 3.4). The feasibility of a joint development of these discoveries is based, to a large extent, on the prices that can be obtained in the natural gas export market of the northeastern United States and the royalties and taxes paid to the federal and provincial governments.

Figure 3.2

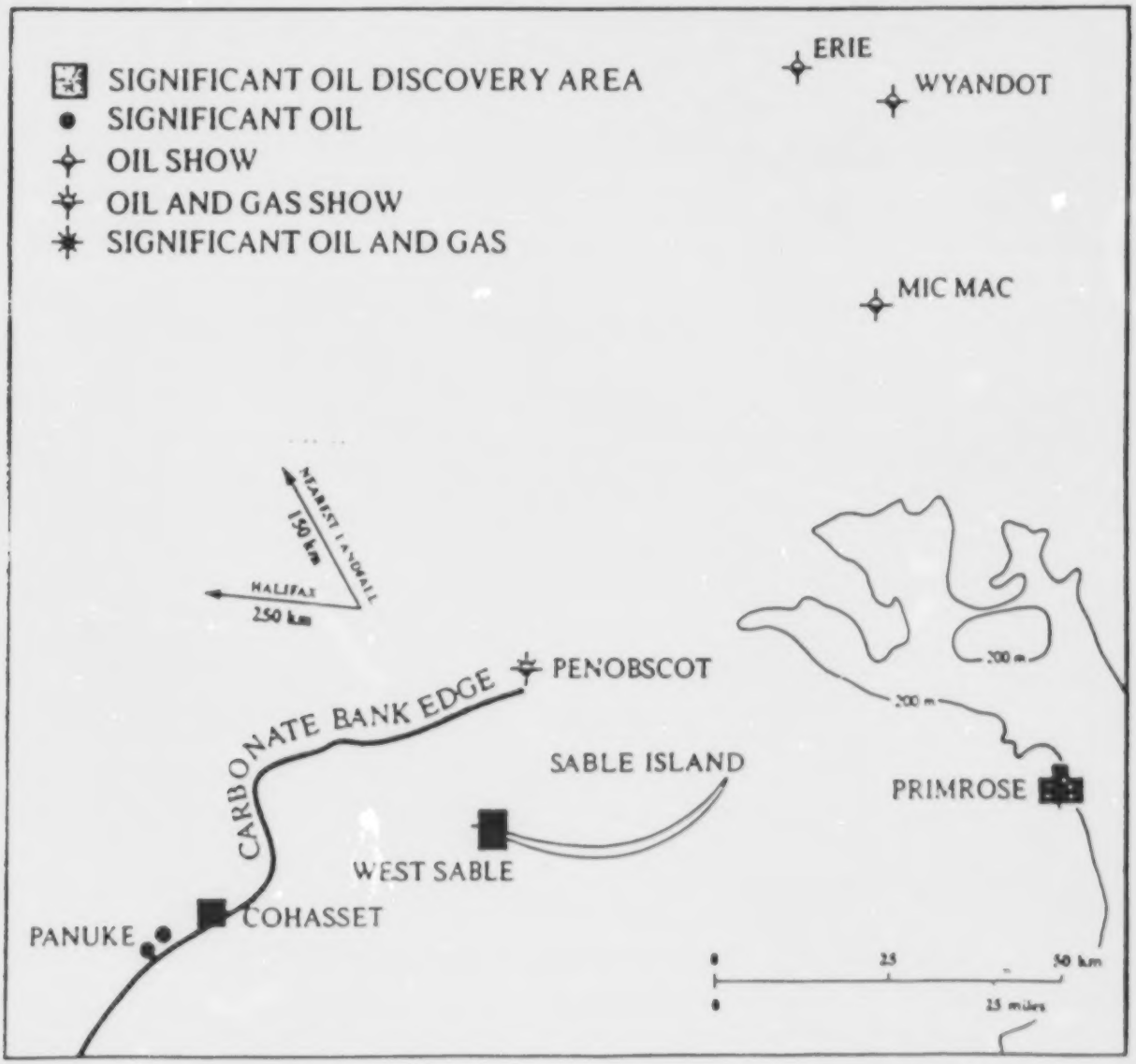
Location of Significant Discoveries, Scotian Shelf



Source: **Petroleum Opportunities - Offshore Nova Scotia Canada 1988**, joint publication by the Canada-Nova Scotia Offshore Oil and Gas Board, the Canada Oil and Gas Lands Administration and the Nova Scotia Department of Mines and Energy.

Figure 3.3

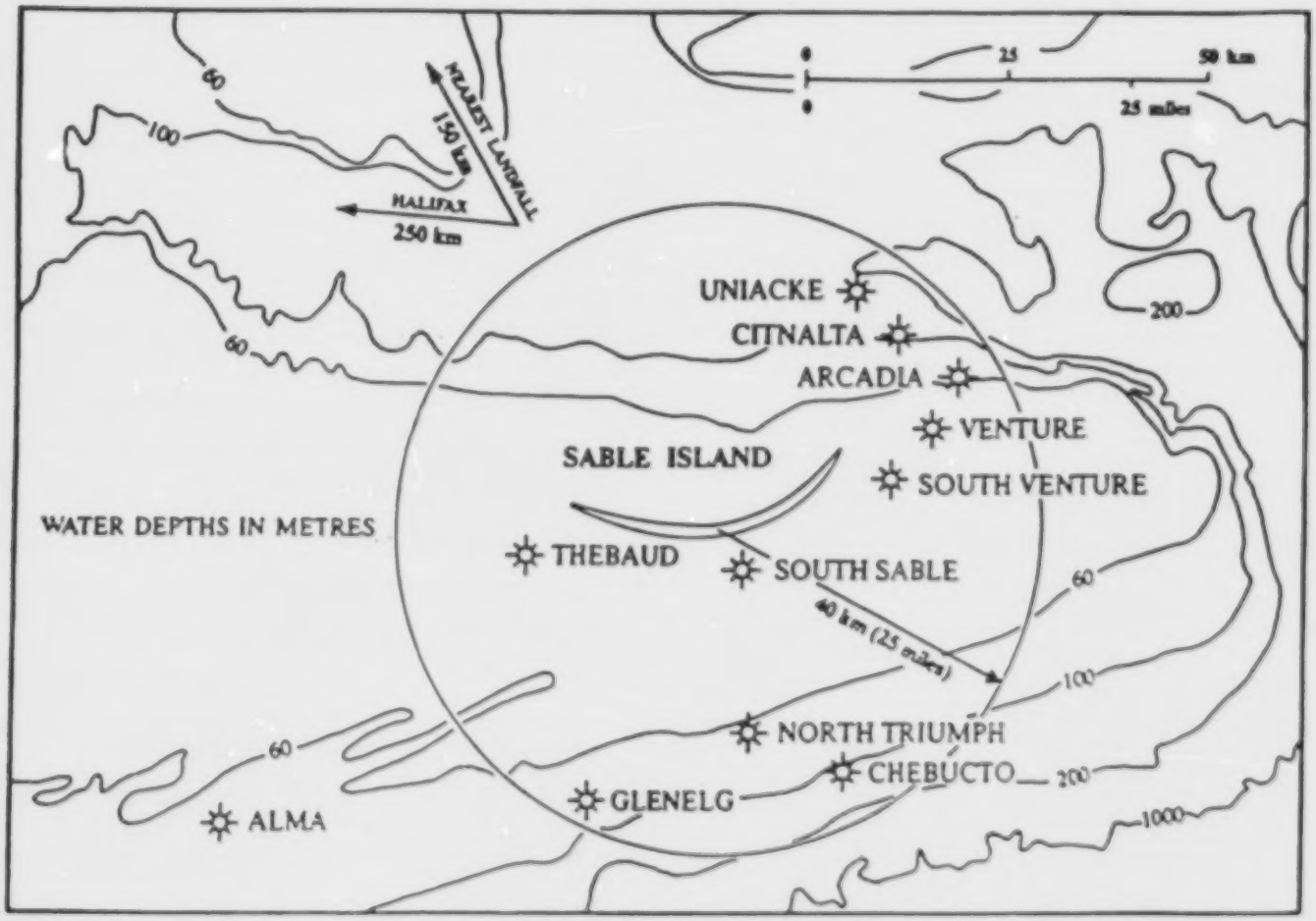
Significant Oil Discoveries and Oil Shows, Offshore Nova Scotia



Source: **Petroleum Opportunities - Offshore Nova Scotia Canada 1988**, joint publication by the Canada -Nova Scotia Offshore Oil and Gas Board, the Canada Oil and Gas Lands Administration and the Nova Scotia Department of Mines and Energy.

Figure 3.4

Major Gas Discoveries in Vicinity of Sable Island



Source: **Petroleum Opportunities - Offshore Nova Scotia Canada 1988**, joint publication by the Canada -Nova Scotia Offshore Oil and Gas Board, the Canada Oil and Gas Lands Administration and the Nova Scotia Department of Mines and Energy.

The export market is necessary to the success of any natural gas project since the Maritime market is much too small to support the large investment required. The price of natural gas in the targeted area is too low to support the required development and the project has, once again, been deferred.

Long-term projects are, in spite of present prices, promising since the northeastern United States markets are growing and a requirement for the gas will ensue.

While Voluntary Planning recognizes that the development of offshore gas may require a large export component, it is recommended that the maximum opportunity be retained to serve the needs of Nova Scotia and to add value to the export.

Voluntary Planning recommends that natural gas, when it becomes available in Nova Scotia, be used in the long term to satisfy specialized energy demands including liquified natural gas (LNG) and compressed natural gas (CNG) for use in transportation and heating. While this market is developing, natural gas may also be used with coal for generating electricity using an appropriate process which offers improved efficiencies and reduced environmental problems.

3.3.4 Emerging Techniques and Sources

What we have chosen to identify as emerging techniques and sources of energy is actually energy that is a result of new technologies. In an absolute sense there is no shortage of energy but there are many problems in making it available at an affordable price and in developing and using it in an environmentally acceptable manner. Although we cannot predict exactly which of the sources listed will become important over time, it is certain that some will.

Coal-Water-Fuel

CARBOGEL is the trade name for the product resulting from a process which converts solid coal into a coal-water-fuel mixture (CWF). CARBOGEL is a replacement for fuel oil, in industrial and electrical utility generating station boilers. In the early 1980's eastern Canada was identified as a suitable location for large-scale pilot testing of CWF because of its dependence on imported oil for the generation of electricity, and its proven coal reserves. In 1982, the CBDC, under a licensing agreement with the Swedish developers of the technology, and under a tripartite agreement with the New Brunswick Electric Power Commission and the federal Department of Energy, Mines and Resources, constructed a four-tonne-per-hour pilot plant for the production of CARBOGEL. Funding was made available under the federal Oil Substitution Program.

Some $20 million has been expended on the development of CARBOGEL - CWF at CBDC since the program began in 1982. In addition, test-burns of CARBOGEL were conducted at New Brunswick Power's Chatham plant. The program is now at the point where the manufacturing process is well

known and viable, but the long-term effects of combustion (on burners, boiler tubes, dust collection, etc.) are still not completely known. That information can really be developed only by continued combustion testing over long periods of time, but that is a costly program and there is no incentive for users to get involved with test programs while the price of oil is depressed.

Similarly, the commercial development of the fuel is retarded by the continuing depression of oil prices, combustion experience and knowledge notwithstanding. For CARBOGEL to be competitive with Bunker 'C' oil, Bunker 'C' would have to be about $25 (Canadian) per barrel, based on current Nova Scotia coal prices.

In 1987 the Minas Basin Pulp and Power Company converted one boiler to CARBOGEL usage, with fuel supplied by the CBDC at a subsidized rate. The project was developed to a stage where the system was burning CARBOGEL, starting at relatively cool temperatures, and alternating with oil for steam generation. A premium quality coal was used in production of the fuel. The Minas Basin project was terminated and the CARBOGEL plant mothballed in 1988 when it was determined that a publicly acceptable rate of particulate collection (90-95%) could not be achieved without a major capital expenditure. Approximately $1.25 million was invested to that point, and it was estimated that an additional $400,000 would be required for the installation of the necessary particulate collection system.

There is a possibility of the conversion of the currently mothballed NSPC generating unit -Tupper 1 - from oil to CWF. NSPC and CBDC have studied the feasibility of converting the boiler and building an adjacent CWF plant to supply the fuel. Under the auspices of the Committee on Atlantic Coal, and cost-shared funding by the CBDC, the province, the NSPC and CANMET (Canadian Centre for Mineral and Energy Technology), stage two would be a review of the economic viability of the project.

The additional combustion testing required and the lack of competitiveness with the use of Bunker 'C' oil at present prices, suggests that CARBOGEL will not have a significant impact as a Nova Scotia energy source for major industrial or electrical generating station use in the next decade.

There remains the possibility of using CARBOGEL as a replacement for the relatively high-priced furnace oil that is burned in small commercial or residential furnace systems. This would require the development of suitable technologies for its application. If successful, it could reduce the reliance on furnace oil which is based on imported crude oil.

Voluntary Planning recommends that the technical feasibility of utilizing CWF in small commercial or residential installations be evaluated to provide an in-province fuel alternative to existing furnace oil based on imported crude.

Fuel Cells

The need for greater fuel efficiencies and minimum environmental effects have increased interest in fuel cell development. First conceived about 150 years ago, the fuel cell remained little more than a technical curiosity until the Apollo space Program in which they provided electrical power and water. Their successful development and use by NASA aroused industry interest and has resulted in

continuing international development and evaluation of low-cost versions more suitable for commercial applications. These include evaluation of prototype 5 MW units for urban power production; operation of smaller 40 kilowatt (kW) units suitable for supplying the electricity and heat needs of a large building such as a hospital or shopping complex; and the development and extended operation of experimental fuel-cell-powered electric vehicles.

The fuel cell generates electricity directly from a chemical reaction. Most early fuel cells have used the reaction between hydrogen and oxygen to produce electricity, with water or steam as the waste product. Other chemical reactions are known which can produce electricity in fuel cells, and in some cases useful by-products. The fuel cell is essentially a specially designed container for the generation of electricity by controlled continuous chemical reactions. The fuels, typically hydrogen and oxygen gases, are added and the waste products water and heat removed continuously. The fuel cell need have no moving parts and is, therefore, quiet in operation. While hydrogen and oxygen are the preferred fuels at present, these are relatively high in cost and may not be readily available.

Considerable development work has gone into using the fuel cell as part of a more complex chemical processing plant which would use cheaper more readily-available fuels such as propane, methane, or methanol together with air and transform these into the hydrogen and oxygen required by the fuel cell. By careful design, the total processing plant can be made more cost effective by using heat and products from the fuel cell which might otherwise be wasted. More extended development has the potential to allow the use of natural unprocessed fuels including coal, natural gas and bio-gas as input to the fuel cell processing system.

Fuel cells produce low voltage D.C. electricity. For most practical purposes where higher voltages are required, a series of identical fuel cells are connected together to give the desired voltage. Where A.C. electricity is required, as in most utility applications, an additional power converter is added.

Like coal-fired steam plants, fuel cells are capable of very high efficiency provided steps are taken to use the waste heat produced. This can be through co-generation of electricity using a conventional steam turbine or other means and the use of any residual low-grade heat for district heating or other commercial use, so that a basic fuel-to-AC power efficiency of 38% for a specific type of fuel cell can be increased to about 90% with waste heat recovery. A 36% efficiency is a comparable figure for a well-designed coal-fired steam plant. Recent developments in improving fuel cell technology have resulted in cells which operate at higher temperatures and pressures, giving higher efficiencies in the fuel cell and waste heat at relatively high temperature with a consequent greater range of applications. fuel cell efficiency is almost constant for varying electrical loads between 20% and 100%.

Chemical reactions within the fuel cell generally require a catalyst which promotes the reaction but is not consumed. Many of the early fuel cells used catalysts which were based on expensive platinum and similar metal compounds. Newer developments are seeking low-cost alternatives for these catalysts.

The fuel cell is not a heat engine and the traditional exhaust products such as CO_2, SO_2 and NO_x which are the subject of increasing environmental concern are not produced. Instead, water in the form of steam is the commonest waste produce and may be valuable for co-generation of electricity, for heating or for drinking water as in the Apollo Space Program.

The capital costs associated with fuel cell installations are falling as development continues and are approaching the $1000/kW total system costs which is often quoted as a standard for new conventional gas-fired thermal generating plants. The shorter lead time, the lack of environmental problems and the greater efficiency of the fuel cell are attractive for operational purposes.

In summary, the fuel cell offers a range of practical advantages over conventional thermal generation of electricity which are likely to increase with continued development. The quiet operation, lack of environmental problems and efficiency maintained over a wide load range make it especially suitable to supply peak load demands with a minimum of transmission losses. It may also be a practical means of retiming tidal power. The integrated system utilizing natural gas, methane or other commonly available fuels may be an attractive way of generating electrical power in remote locations not easily and economically accessible by transmission lines. The development of fuel cells which have a high ratio of electric power/weight could lead to a revival of the electric vehicle for urban transportation.

The fuel cell overcomes the present problems of the weight and long recharge time of conventional storage batteries, while avoiding pollution problems associated with exhaust gases from internal combustion engines.

Voluntary Planning recommends that there be an ongoing evaluation of fuel cell technology development as a means of generating electricity from local coal with a minimum of environmental impact, and as a practical way of retiming tidal power.

Integrated Gasification Combined Cycle Technology

In 1987 NSDME began an assessment of integrated coal gasification combined cycle (IGCC) technology for electrical generation. At that time, IGCC had been identified as a promising technology for addressing the environmental problems associated with coal utilization. A clean-burning gas is created by reacting coal with oxygen and steam. The gas is then burned to drive a combustion turbine while raising steam with recaptured heat to drive a steam turbine (combined cycle). Both the coal gasifier and the gas turbine are modular units.

Since 1987 NSDME has awarded several contracts in their continuing evaluation of IGCC technology. The CBDC, NSPC and CANMET have also been active participants in this assessment through separate contracts and more recently through projects funded under the NSDME/NSPC/CBDC Coal Research Agreement.

Results from each of the studies completed to date have been encouraging and have led to follow-up action. The assessment continues with the goal of readying the technology for commercial application in Nova Scotia. At this time, it is predicted that IGCC technology will be an option in Nova Scotia for power plants coming on-line by the turn of the century. The projects completed, in progress, or planned, are complementary. Each project addresses specific questions which must be answered prior to a commitment to IGCC for commercial application. This overall technology assessment very closely parallels the extensive evaluation undertaken for fluidized bed combustion technology in Nova Scotia which was initiated in 1982. Increasingly-stringent environmental guidelines will force coal users, coal producers and government to look for technologies that can meet both energy and environmental challenges of the future.

Methane Recovery

NSPC, CBDC and NSDME are undertaking a feasibility study into the use of methane collected from the Lingan and Phalen collieries to generate electricity at the Lingan power plant. The methane would be derived from both the return ventilation air and the methane drainage system at the mines, and transported by either one or two pipelines to the power plant for use with coal in existing boilers.

If the study proves the project to be feasible, the project would have the following benefits:

a) utilization of a currently wasted energy resource;

b) reduction in the contribution to the greenhouse effect of methane currently released from the Lingan and Phalen mines. With respect to the greenhouse effect, the utilization of methane from the Lingan and Phalen mines is equivalent to eliminating CO_2 emissions from the combustion of over one million tonnes of coal per year. This is because the relative "greenhouse strength" of methane is 20 - 30 times that of CO_2, although CO_2 endures much longer in the atmosphere; and,

c) reduction in SO_2, NO_x, and CO_2 emissions from the Lingan Generating Station by virtue of substitution of methane fuel for some of the coal feedstock.

Voluntary Planning recommends that studies of ways in which methane vented from coal mining operations can be used as an energy resource be continued and acted upon where appropriate.

Solar Energy

Solar energy systems could contribute to Nova Scotia's energy supplies in three areas.

- Passive solar heat gains can supply a large percentage of the heating needs of almost any building that is designed and constructed to take advantage of the energy source. This can usually be done without adding significantly to construction costs. Almost all buildings receive some passive solar heat input.

- Active solar domestic hot water (DHW) systems have become less expensive and much easier to install. Residential solar DHW systems retailing for approximately $1,000 can be a worthwhile investment for persons willing to consider total costs over the life of the unit. Solar DHW systems may increase their market share substantially in the foreseeable future, as energy prices rise due to international pressures or tax changes. Canada's largest solar panel manufacturer is a Nova Scotia firm, Thermodynamics Limited.

- Photovoltaic (PV) technology continues to improve its conversion efficiency and reduce costs. PV systems are viable now in many remote locations for specific applications but probably will not become competitive for electrical consumers with access to the NSPC grid because of the additional costs associated with storage and D.C.-to-A.C. conversion.

The Scotia Synfuels Project

The Scotia Synfuels project has long been promoted by a group led by the Honourable Alastair Gillespie as a viable means of utilizing Cape Breton high-sulphur coal and as a job creation project for the Port Hawkesbury and industrial Cape Breton areas of the province.

It is certainly true that new ways must be found to use high-sulphur coal or the increasing public concern over environmental problems including acid rain will ensure that coal production will drop drastically in Cape Breton.

The proponents of the project have proposed a 4.0 million barrel-a-year plant. This will require approximately 400,000 tonnes of coal plus imported heavy crude oil, as feed stock. The project could be followed by additional units of the same size.

The sulphur, extracted in the process, becomes a valuable by-product, reducing the overall cost of production. Bench-scale test work has confirmed the suitability of high-sulphur Nova Scotia coal for co-processing and the overall operability of the process.

Government incentives are essential to attract private sector participation, consequently the project's backers had been requesting funding both under various Cape Breton incentive programs as well as interest buy-down. The federal government has recently decided not to grant an investment tax credit for the project.

Voluntary Planning gives general support to the concepts of the Scotia Synfuels project, but lacks sufficient information to justify recommending direct financial support to the Government of Nova Scotia, unless such support is justified by significant and credible private sector investment.

Alternative Transportation Fuels

The long-term substitutes for petroleum as a transportation fuel in Nova Scotia are difficult to predict until a relatively-secure and cost-effective alternative source of supply becomes available.

Advances in alternative transportation fuels (ATFs) technologies are being made by other jurisdictions which have access to fuel sources other than refined petroleum products and a more immediate stake in more widespread use of ATFs.

In the foreseeable future, concern over clean air (greenhouse effect, carcinogens, etc.) will likely be the primary motivating factor in ATFs research, development and demonstration, adding to the importance of economic and energy-related factors.

Significant new technological improvements in developing higher-quality diesel fuel, with lower sulphur/aromatics, are currently taking place which may affect the priority placed on ATF's developments.

Conventional transportation fuels are proven, reliable and relatively low cost in comparison to ATFs. ATFs are either not indigenous to Nova Scotia or not produced locally in significant quantities. This limited supply results in relatively high current and anticipated prices for ATFs. Additional barriers to the use of ATFs include:

- concern about safety
- vehicle conversion costs
- maintenance and performance of converted .vehicles
- convenience and availability of fuelling facilities
- advances and refinements in conventional fuels technologies

Energy-from-Waste

Energy-from-waste facilities which incinerate solid or liquid waste and produce either electrical or thermal energy or both have been operating in Canada and the United States for many years. These plants have been constructed mainly for waste disposal in areas where other alternates such as landfill were not readily available.

The financial viability of these facilities varies with factors such as price received for energy produced and tipping fees paid by those depositing waste. If tipping fees are set high enough and if favourable contracts for sale of energy are secured, then the plants may be run on a profitable basis. Current low oil prices mean lower than predicted energy revenue from many existing plants. Under normal circumstances where other options are available for waste disposal, life-cycle costs for energy-from-waste plants will be higher than other common methods of disposal, thus creating a need for a subsidy. Typical municipal waste-disposal costs in Nova Scotia are in the $10-$20 per tonne range. Disposal costs involving energy from waste facilities typically are in the $40-$90 per tonne range.

An additional element which impacts on the cost of energy-from-waste plants is the requirement for effective control of emissions from the combustion process. Environmental standards are becoming more stringent, and many jurisdictions are concerned about the possibility of additional environmental controls which may become necessary at substantial costs after facilities are constructed.

Voluntary Planning recommends that the Government of Nova Scotia support the concept of using municipal solid waste as an energy resource provided that the environmental impact is no more than that associated with land fill disposal, and that the price paid for the energy produced is competitive.

Wave Motion

Development of a means for producing energy from the movement of waves has continued for an extended period of time in several countries, principally in England and Japan.

The availability of more traditional and cost effective energy sources from coal, oil and gas, with time proven technologies, have inhibited commercial application in the U.K., though a producing system is in operation in Norway. Recent re-evaluation of the costs associated with wave generated energy and the lack of environmental problems associated with traditional fuel combustion may favour future use of this method of harnessing renewable energy.

Since the energy density in waves along the Nova Scotia coast is much less than that contained in the waves off the English or Irish coasts, little likelihood exists that the use of wave energy will be of any practical interest to the province in the foreseeable future.

Wind Energy in Nova Scotia

The largest wind energy system in the province is NSPC's 300 kW unit in Wreck Cove. It has had substantial downtime since it was originally erected. In the 1980's, ten to twenty residential wind turbines were operating but most are now inoperative or have been dismantled. The largest residential unit now operating is a 10 kW unit in the Hantsport area.

Internationally, the performance and reliability of larger wind turbines continues to improve, but the units are still cost effective only in regions with high electrical costs or in remote areas. Substantial rationalization of the wind energy industry has taken place recently. Very few firms now manufacture residential units. Because of windspeed fluctuations, these units are not suitable for base load operations unless associated with a storage system.

Wind energy's impact on Nova Scotia's electrical supply capability is likely to remain very small for the foreseeable future.

3.4 Public Utilities Board

3.4.1 Purpose and Authority

The Board of Commissioners of Public Utilities (PUB) is constituted under the Public Utilities Act of the province of Nova Scotia. This Board is responsible for the regulation of all public utilities including tram-ways, busses, equipment and service of telephone companies, equipment and service to provide electricity to the public, equipment and service for the sale of gasoline to the public (it regulates the maximum posted prices on most petroleum products), the distribution of water and steam heat to the public for compensation.

The PUB also administers a number of other acts including the Motor Carrier Act, Salvage Yard Act, Auto Insurance Act and the Gasoline and Fuel Oil Licensing Act. The regulation of telephone companies applied to MT&T until recently when it was placed under federal jurisdiction by the Supreme Court.

The regulation of electric utilities is exercised over NSPC and seven municipal utilities. It includes the setting of rates and charges, approval of rules and regulations under which services are given and approval of all capital expenditures of $5,000 and above. The PUB does not have any authority to regulate the borrowing of these utilities even though it can regulate expenditures.

3.4.2 Present Role and Function

The original function of the PUB was one of jurisdiction acting as a Court of Law. In this role, it ruled on the requests for rate and regulation changes to protect the public interest. Its major concern was to ensure that all rates were just and equitable and that they were justified by the costs incurred by the utility.

In recent history, the function of the PUB has moved away from the Court of Law to that of a Board of Inquiry. Recent rate cases have initiated inquiries into many areas of NSPC's management, administration and finance. The PUB has made rulings not only on rates and regulations, but also on a desirable financial structure, amount of equity required, etc.

A large number of intervenors have also appeared at recent Rate Cases, some requesting changes to the rates that were proposed and others representing community interests commenting on various aspects such as the generation expansion plan, emission control philosophies and other concerns.

Voluntary Planning believes that the PUB serves a useful function as a Board of Inquiry and a Regulatory Agency and as such must function independently.

3.4.3 Evaluation of Effectiveness

(a) Public Utilities Act

The PUB Public Hearing process for utility rates changes is a useful public forum in which all interested parties have the opportunity to question the proposed expenditures and to offer comment in an orderly formal process which has legal jurisdiction. One might say that in this way the public interest is served. In regulated utilities, rates are set to produce the amount of revenue needed to cover costs for the rating period. However the Public Utilities Act requires that rates for each classification of service must be set to recover only the costs of providing that class of service, i.e. for each class the ideal would be a 100% revenue-to-cost ratio.

When a utility offers several classes of service (e.g. domestic, commercial, industrial, etc.), the situation of under- or over-recovery may occur.

In 1989, the PUB set a range of 95% to 105% as desirable and ordered NSPC to bring its rates to this ratio in subsequent rate applications. If this adjustment is made, the rate increase for each class of service will be different, and if the spread is large, several years may be required to bring these ratios into the desired range.

Continual attention to the revenue-to-cost ratio is required because the revenues and costs of the various classifications change over a period of time causing the ratios to move out of the desired range.

> **Voluntary Planning supports the request of the PUB that NSPC work towards achieving a closer balance between residential and commercial/industrial cost recovery rates.**

It is essential that the PUB is independent of Government to ensure an objective viewpoint that can evaluate all evidence and rule in the public interest. At the same time, the cost of the Hearing process as currently carried out is relatively expensive. In the case or the 1989 Hearing, involving NSPC, NSPC costs alone are likely to be over $1 million for the three-week Hearing. To this must be added the cost of the PUB expert witnesses and PUB expenses, all of which are charged back to NSPC. It is very likely that these costs will affect the electricity rates by at least 0.1%.

Voluntary Planning recognizes the need for a public forum to review and inquire into utility rate applications. Every effort should be made to simplify the review process, to ensure that effective public input is achieved while minimizing the expense.

In 1989 an amendment to the Public Utilities Act resulted in the suspension of the Hearing process for a new power plant. While this may have expedited the start of construction, the opportunity for public input has been curtailed. In being site specific, the amendment (Bill 76) acted to prevent the PUB from reviewing one specific project (Point Aconi) but did not change the terms of reference of the Public Utilities Board.

Voluntay Planning recommends that the PUB continue to function as an impartial Board of Inquiry scrutinizing all capital expenditures of NSPC, however, the present limit of $5,000 above which PUB approval is required, should be increased to a more appropriate level for this corporation.

(b) Gasoline and Fuel Oil Licensing Act

Concerning the PUB's administration of the Gasoline and Fuel Oil Licensing Act, Voluntary Planning recognizes that there are a number of product/market issues warranting consideration, such as limiting the number of retail outlets and legislative amendments to allow for self-service gas stations. It is recommended that further studies be carried out.

3.5 Nova Scotia Power Corporation

NSPC supplies most of the electric power and energy used by the citizens of Nova Scotia. Electrical energy supplied by NSPC represented 17% of the total end use energy in the province, and NSPC used 35% of the total primary energy consumed within the province.

NSPC has stated that it has a dual mandate:

(a) To satisfy the needs of Nova Scotia for reliable, economic electrical service in a safe, effective and environmentally responsible manner while fostering the wise and efficient use of energy,

and as a crown corporation,

(b) to serve the broad social and economic interests of Nova Scotia.

NSPC is a regulated monopoly so that for electricity the discipline of the market is less evident than in the case of other commodities. Some hold the view that the electrical energy supply to the customers in Nova Scotia could be better provided by the private sector.

NSPC has been subject to considerable public scrutiny and criticism in all aspects of its operation. This is to be expected for a large corporation which is publicly owned, whose product is used by every citizen and which has a large capital expenditure program.

The PUB has, in the past and on an on-going basis, carried out detailed analysis of the corporation's activity and has come to the conclusion that quality of service and operating efficiency are satisfactory. It has indicated some concern about the level of reserves and the need for an interest coverage ratio greater than 1.0. It has directed NSPC to recover financial revenues in excess of expenses to meet this objective. Capital and operating statistics for NSPC are provided in Appendix C.

Recent media criticism of NSPC has suggested that NSPC is embarking upon a capacity expansion program which is unnecessary. Voluntary Planning prepared a detailed set of questions which it directed to NSPC and later met with NSPC planning personnel to discuss load forecast and generation planning procedures.

Voluntary Planning has no hesitation in accepting the load forecasts made by NSPC based upon the accuracy of past demand forecasts and the resultant need for additional generating capacity.

Since the forecast load plus the reserve criteria determines the need for capacity, Voluntary Planning did a cursory review of reserve requirements on other utility systems. While it realizes a full analysis of this is detailed and complicated, it is satisfied that NSPC's reserve criteria is not excessive. On this basis, Voluntary Planning accepts the need for additional capacity.

NSPC has, following ten years of load research and experimentation, commenced a program of demand side management initiatives with an objective to achieve a reduction in demand of approximately 150 MW by the year 2000. These programs will be developed and delivered under the title of Power Smart (see Appendix C-7).

Voluntary Planning recognizes the value of conservation programs (such as Power Smart) in reducing the demand for energy in general, and electricity in particular, and recommends that support be given to identifying and implementing new economically viable programs for this purpose.

The role of private producers in generating and selling electricity in various jurisdictions has been the subject of considerable discussion over the last decade. Estimates suggest that 100 MW could be supplied by private producers in Nova Scotia if there is sufficient price incentive. The actual amount of private power available will depend on the price paid by NSPC and the cost effectiveness of the private suppliers.

Voluntary Planning concurs with the recently announced PUB decision that the price paid to private power producers for electricity should not exceed the avoided costs for NSPC.

Nova Scotia has very little, if any, untapped hydro. Nuclear power is of such a scale as to be inappropriate for Nova Scotia use at this time and the government has decided that NSPC is not to generate electricity using nuclear power. Natural gas is not yet available and Voluntary Planning believes that to go back to former reliance on imported oil would be imprudent. Lastly, the ability to purchase significant amounts of power from external sources over the next decade appears to be negligible, as both Hydro-Quebec and New Brunswick Power have to make large additions to their systems for their own use.

In reviewing the options available to NSPC, Voluntary Planning accepts that at this time the only viable option is to generate electricity within the province utilizing Nova Scotia coal as the primary fuel.

The construction of new coal-fired generating capacity within the province is therefore the only viable option at this time. The adoption of coal as the principal energy source has been the topic of much discussion by Voluntary Planning. The conclusion continues to be that Nova Scotia coal at its present subsidized price is the most economic primary fuel supply available to NSPC. With an uncertain future for federal support and increased public concern about the environmental impacts of coal mining and combustion, this conclusion should be reviewed on a regular basis.

Voluntary Planning recognizes that, at present, in order to provide coal at a competitive market price, CBDC requires direct and indirect subsidies from its owner, the Government of Canada. With the moves by the Government of Canada to turn over crown corporations to the private sector, Voluntary Planning is concerned that the price of coal mined by CBDC in Nova Scotia may not continue to be competitive with other suppliers. This could create a problem for NSPC, CBDC and the provincial government, if coal from outside Nova Scotia becomes more economical.

It is recognized that there is a requirement to implement effective and economic means to minimize the effect of energy production and use on the environment. NSPC's recent decision to install a circulating fluidized bed (CFB) generating plant at Point Aconi should assist NSPC and the province to meet the current requirements of the federal/provincial acid rain agreement and address the evolving concerns about NO_x. Voluntary Planning accepts the need for higher cost technology to meet requirements of reduced SO_2 and NO_x and accepts that the CFB technology is a means of achieving this.

Voluntary Planning recommends, to avoid significant waste disposal problems, that development work be commissioned to establish cost effective ways of using the waste products from CFB combustion as a raw material for manufactured products.

Voluntary Planning has noted the concerns expressed by the public and media on the way in which the Point Aconi project was approved. Voluntary Planning believes that the project should have been scrutinized by the Public Utilities Board as all other generation unit additions have been since 1976. Voluntary Planning realizes that the Point Aconi project was subjected to more environmental assessment than other projects of NSPC but feels that this was a necessary consequence of growing public concerns for the environment.

On the export side, the corporation has been pursuing the development of an external market for electrical energy based on the utilization of Nova Scotia's coal resources. This could have a two-fold benefit in providing additional demand for Nova Scotia coal and economy of scale for NSPC. Specifically, the corporation is developing a plan to export power to New England by high voltage undersea cable.

Voluntary Planning endorses the efforts to develop external markets for electricity generated from Nova Scotia coal provided there are social and economic benefits to the province and the local consumer of electricity, and that the environment can be adequately protected.

3.6 Conservation

Conservation and the environment are both extremely important issues; but environmental concerns have come to the fore in the perception of the public. The potential for conservation has, however, become the subject of a disproportionate amount of publicity and has been given as a means of halting the increase in energy use to the point of avoiding the necessity to construct additional electrical generating facilities. It can without doubt, supply some of our energy requirements in a cost effective manner but will not approach that needed to meet our future needs.

While it is true that the desire to conserve has resulted in more efficient energy use since the first oil price shocks of 1973, it is equally true that the use of energy has continued to increase. This growth is not only due to the fact that the under-developed countries are actively seeking to industrialize, but that the economies of developed countries have continued to grow.

Currently, renewable energy sources (including hydro power and biomass) account for 18% of the world energy needs, while nuclear accounts for 4%. The remainder is met by fossil fuels [1]. As yet there is no solution to the problem of trying to maintain a viable global ecosystem while meeting the growing demand for energy.

Although per-capita energy consumption in Canada is high, it may be attributed to the energy intensiveness of many industries, including agriculture, as well as high fuel consumption for both heating and transportation necessitated by our climate and size. Having said that however, it must be admitted that as a society we waste energy!

Voluntary Planning recommends that an effective and sustainable energy policy adopt appropriate advances in technology at every stage of the energy cycle, to improve the means by which we find, process, transport and use energy.

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[1] Scientific American, September 1990 - Energy for Planet Earth

Improvements in building materials can sharply reduce the loss of heat through walls, doors and windows. In industry, sensors and controls, advanced heat recovery systems and friction-reducing technologies can decrease energy consumption. Industries such as paper can institute specific efficiency measures such as automated process control, higher process speeds and high-pressure rollers.

In many instances, the introduction of new manufacturing processes has had the added benefit of lowering the environmental impacts of the industries concerned. In the case of Bowater Mersey, Liverpool, its conversion to the Thermal Mechanical Pulping Process (TMP) has not only increased production efficiency, but has drastically reduced the plant's environmental impact. What is not generally realized is that the increased requirement for electricity to meet the new process demands has transferred responsibility for a portion of the former environmental impact to NSPC. Similarly, while introduction of the Sydney Steel Corporation electric arc furnace has dramatically reduced the contribution, in Nova Scotia, of pollution by the steel industry, it has transferred a portion of it to NSPC. Such actions have, however, resulted in a net benefit to the environment of the province.

Opportunities for realizing increases in efficiency by the private citizen (in addition to more careful use) are limited to the procurement and use of the more energy-efficient cars, homes and domestic appliances now available. Studies by the Congressional Office of Technology Assessment show that the improvements in energy efficiency between the existing "in-use" models and newly-available models of cars is 50%; homes 40%; refrigerators 25%; gas furnaces 15% and air conditioners 30%.

Energy-related decisions are not always totally dictated by economic considerations. Other motivating factors which commonly go hand-in-hand include occupant comfort in the residential sector, safety in transportation and production process improvements in industry.

Despite fluctuating energy prices, significant business opportunities exist to supply and/or install cost-effective equipment, such as energy management systems, energy efficient lighting and high efficiency heating systems and windows. In response to the problem of availability of capital funding in the institutional and commercial sectors, energy service companies are becoming increasingly active in retrofitting buildings.

It is worthy of note that Nova Scotians consume electricity at a rate of only 55% of the average Canadian; but electricity is increasing its share of total end use in Nova Scotia, as it is in Canada. This is also true on a global basis as societies have converted from alternate energy forms to electrical use.

In the case of both industry and private applications the speed of the market penetration of new energy-efficient technologies is likely to be slow because of the requirement for substantial capital investment to replace existing equipment, homes etc. with their more efficient successors. Neither the industrialist nor the private citizen will make the necessary investment unless the pay back-period is relatively short.

It will be necessary that the government encourage an informed public to realize that conservation as we define it does not mean a lowered life-style. It is simply a question of - not how much energy we use but how economically we use it. It is highly likely that a knowledgeable public will demand minimum efficiency standards on all new appliances to aid the trend towards energy efficiency and avoid the necessity of government-imposed ones.

It is recommended that NSDME in cooperation with NSPC identify and cost all significant approaches to energy efficiency and the conservation of energy, whether from electricity or other sources, and that this information be made available to the general public in a suitable form.

In spite of the fact that the federal government should be taking a leading role in educating the public on means of realizing energy efficiency, it has been sending very different signals by making major reductions in funding designed to support energy efficiency programs. In addition, all twelve regional Conservation and Renewable Energy Offices across Canada have been closed. The provincial government has, on its own initiative, continued and expanded the Energy Analysis Program to assist industry in the identification and examination of the cost effectiveness of energy saving opportunities. Also the provincial government has made available an energy advisory service which offers advice on energy-efficient housing and heating systems.

It is recommended that the Government of Nova Scotia continue to offer the Energy Analysis Program and advisory service, as well as develop conservation-related demonstration projects.

It is concluded that even if all the identified efficiencies in energy use were realized, it would not negate the necessity to construct new electrical generating plants. They would still be necessary to meet future electrical demands created by economic expansion, population growth and the increasingly improving standard of living.

In planning new thermal generating plants, every effort should be made to ensure maximum utilization of the energy released by combustion. In particular consideration should be given to the use of low temperature waste heat from cooling water to provide industrial or district heating.

3.7 Energy and the Environment

Man's use of energy can have a harmful effect on the environment. The rising demand for energy is causing concern that these harmful effects will increase, and may even result in irreversible changes on a global scale. The processes include acid rain, the greenhouse effect, and possibly ozone depletion.

With a few exceptions, the energy itself is not the problem, rather it results from the ways by which man transports fuels and produces energy in a usable form such as electricity, gasoline, and hydraulic power.

Traditionally, the energy industry has been more concerned with minimizing the cost of the energy distribution and production than avoiding harmful effects on the environment. Only when the harmful effects increased to levels which have substantial and proven effects on public health or amenities has action been taken. With increasing longevity and the growing awareness that even low level effects may have long-term impact, there is growing recognition that emissions standards and methods of disposal of non-gaseous wastes which were common in the past may no longer be publicly acceptable in the future. This has already had significant effects on the way in which energy is produced and used today. Examples include banning of lead-based additives to gasoline, innovative ways of transforming fly-ash from a disposal problem into a useful raw material, and the development of new, more-efficient combustion processes.

The increasing scale of energy production has resulted in a corresponding increase in the size of tankers, power stations, hydro projects, and other associated facilities. As a result, mishaps, when they occur, are larger and have a wider impact on the environment. A gas pipe line failure in a city may affect a few blocks, a super tanker running aground in Alaska causes environmental damage over hundreds of square miles, the Chernobyl Nuclear Plant disaster spread radio-active material over many countries.

3.7.1 Air Pollution

Urban air pollution is an increasing problem for cities as wide-spread as Tokyo and Mexico City.

In a few cities, including Athens and Los Angeles, pollution levels are at times so severe that local and state governments are being forced to develop legislation, taxation and other methods to encourage the use of smaller and more-efficient cars, and to encourage a shift from the car to alternative methods of public transportation. In addition, alternate methods of powering cars are being developed which overcome the exhaust gas problems of the internal combustion engine. These include battery operation, fuel cells and in the longer term the use of hydrogen as a transportation fuel. Although no Canadian cities have experienced air pollution of the severity that is common in Los Angeles, it is likely that Toronto may see a continued trend to higher air pollution indices unless a more concentrated effort is made to overcome the problem. As an alternative to the use of the motor car, the development of public transportation in the form of a more efficient system combing rail, subway, and bus is likely to be a favoured solution which is already being followed in London and Toronto.

Air pollution has long been known to be associated with health problems especially in city areas. In the past, London has demonstrated how government can reduce the problem of air pollution from domestic and commercial heating by appropriate clean air legislation encouraging different forms of heating. Today, urban problems are more often associated with air pollution by cars, buses, trucks and other types of transportation. The US government and those of other countries are adopting national standards of increasing severity designed to reduce air pollution from transportation by encouraging a shift to smaller, more efficient engines, operating in ways which reduce the amount of pollution exhaust gases produced. Because of the long lead time to develop and manufacture new lean-burn engines, the more easily adapted catalytic converter has been the preferred route for many car manufacturers to meet the emission standards. While standards in Canada are generally lower than the USA, the proximity of the two markets and the increasingly international nature of car manufacture and sales will result in Canada receiving benefits from improved car engine performance, despite lack of domestic initiatives.

3.7.2 Global Warming[1]

The increasing concern for the environmental changes that could result from global warming (the greenhouse effect) and the recognition that CO_2 may play a major role is likely to favour energy sources which do not release CO_2 to the atmosphere. For while it is possible to

[1] See Appendix "A"

remove CO_2 from the exhaust gases of an internal combustion engine or a furnace, the cost is likely to be high and the technology is not well developed. Non CO_2 producing energy sources include nuclear, hydro, geothermal, solar, tidal and wind. Of these, only nuclear and hydro are significant sources of energy at this time, and while these do not cause CO_2 emissions, they can have other environmental problems. For nuclear power, operational problems may produce the risk of exposure to radiation and there is still the question of how to safely decommission and dispose of the radioactive material from these plants, while for hydro there is a growing awareness that large schemes can have a negative effect on the local environment and native people by interfering with river and stream flows, affecting wild life, and in some cases modifying local climate.

3.7.3 Acid Rain

While disasters make the headlines and attract public attention, a less-dramatic but long-continued assault on the environment may in the long-term be of greater significance because of its potentially global spread. Acid rain which in the case of Nova Scotia originates from pollution of the air by industrial plants outside the province, and in all probability the country, has had a considerable effect on the lakes and rivers of the province killing fish stock. In addition, evidence from Europe has identified acid rain as the probable cause of stunted growth, disease and death in the trees of the forests.

In conclusion, the former "laissez-faire" attitude to the impact of man's use of energy on the environment is being replaced by one of increasing public concern. This trend is likely to continue and will pressure government to produce further legislative and other responses to minimize environmental effects. The cost of meeting these requirements will ultimately be borne by the public either directly in the form of increased costs for energy, or indirectly in the form of higher costs for the goods and services which use the energy. Any government subsidies to help cover costs of equipment or procedures to overcome environmental problems will also require funding from the public purse.

One desirable effect is that higher energy prices may act as an effective means of encouraging energy conservation by the private user and small business who are difficult targets for conservation policies and legislation.

For Nova Scotia, the most immediate problems will likely centre on how to continue to favour the use of Nova Scotia coal as an energy source while meeting increasingly-stringent standards for waste emissions. Initially, SO_2 will likely be the main concern, but this could be overshadowed by concern about CO_2 release if current ideas on the cause and severity of global warming are confirmed. These factors require continual study to determine if the increasing concerns are warranted.

Voluntary Planning recommends that within the Halifax-Metro area, efforts continue to develop a comprehensive public transport system as a viable alternative to the private car and which is less stressful to the environment.

For longer-distance transportation, the cutting back of rail services in the province has effectively reduced the available options to the use of road transport. Since it may become desirable to reinstate selected rail services in the future, it is important that the rail-bed and rights-of-way are not abandoned or destroyed without careful thought to future needs. The future availability to the public of other transportation options besides the automobile may be necessary to help reduce waste emission from this source.

Voluntary Planning recommends that the Government of Nova Scotia preserve the rail-bed and other rights-of-way against future public needs to establish alternatives to road transportation.

Appendix A

The Ozone Layer and the Greenhouse Effect

THE OZONE LAYER AND THE GREENHOUSE EFFECT

AN OVERVIEW

Scientific interest in the Ozone Layer and the Greenhouse Effect has been increasing rapidly during the last ten years. More recently the general public has become aware of the issues raised through articles in the media. Some of these issues may have relevance to energy use in Nova Scotia in the long term. This paper attempts to give a summary of the situation and review some of the implications.

The Ozone Layer

In outer space, radiation from the sun includes light, heat and ultra-violet. Ultra-violet light is used commercially, as a sterilized agent and excessive exposure may cause skin cancer in man and harm or kill plants. Fortunately for life on earth most of the excess ultra-violet in the sun's rays is filtered out by the earth's atmosphere. The main filter is believed to be the gas ozone which is found in low concentration in the upper part of the atmosphere. Given the importance of this ozone layer to life on earth, knowledge about its distribution is important.

Studies on the concentration and distribution of ozone in the atmosphere were initially of limited extent and made from ground land stations. More recently the Nimbus 7 Satellite has given a more complete global picture for the period 1979-1986. The results of this satellite survey (Figure 1) show a seasonal variation of about 7% but in addition there is a general trend for the ozone concentration to diminish at the rate of about 1% per year.

A more detailed analysis of the satellite data shows that this fall in the concentration of ozone is most prominent in polar latitudes reaching about 2-3% per year and at the same, the seasonal variations are greater (Figure 2). This satellite data agrees with ground station and airborne data gathered by British and American scientists in Antarctica which has shown seasonal variation in the total ozone of up to 50%, with some layers in the upper atmosphere depleted by 95%. In addition, these scientists found evidence of a reduction in ozone of about 5% in nine years.

More recent observations by Canadian and other scientists in the Arctic have provided some evidence of research ozone depletion in that region.

The causes of the seasonal variation in ozone concentration and the long-term trend to lower ozone concentration are not well understood. There are number of scientific theories, but there is a shortage of experimental and observational data to test these theories. But the main concern is that man-made chemicals such as chloroflurocarbon, when released into the atmosphere, are depleting the ozone layer. Chloroflurocarbons have been used extensively as fluids for refrigeration and as the pressurizing gas in paint, deodorant and other aerosols. Alternatives to the chloroflurocarbons are being introduced by industry and

national governments are now moving to pass legislation to restrict the use of these chemicals. Time delays in implementing legislation, replacing commercial products and the slow rate of elimination of existing chloroflurocarbon from the atmosphere make significant reductions in ozone depletion unlikely in less than a decade.

Public concern is justified by estimates that a 2.5% reduction in ozone could lead in time to a 10% increase in skin cancer. For the mid latitudes in the northern hemisphere the present trend would give a 2.5% reduction in ozone in about three to four years.

The consequence of further ozone depletion on plant and animal life is an additional cause for concern but further studies are required to assess the probable impact.

In summary: There is evidence that the ozone layer which screens out harmful ultra-violet radiation from sunlight is being depleted. The most probable cause of ozone depletion is the discharge into the atmosphere of man-made chemicals - the chloroflurocarbons. Additional scientific work is required to give a more accurate measure of depletion rates with time and location, and to gain a better understanding of the processes involved and the effects on living organisms. Action to reduce the use and discharge of chloroflurocarbons into the atmosphere is prudent, given the potentially serious consequences of ozone depletion.

The Greenhouse Effect

The earth's atmosphere helps to maintain surface temperatures by reflecting back to the surface thermal radiation which would otherwise be lost into space. It is estimated that this greenhouse effect is responsible for about 83% of the energy that arrives at the earth's surface, the remaining 17% is from the direct rays of the sun. It has been computed that if there were no greenhouse effect, temperatures at the earth's surface would be some 30 degrees lower with major consequences on animal and plant life.

The atmosphere is composed predominately of nitrogen and oxygen, but these are essentially transparent to solar radiation and play no part in the greenhouse effect. It is the presence of relatively minor amounts of carbon dioxide, water vapours, methane, nitrogen oxide, ozone and the chloroflurocarbons which give the greenhouse effect. Changes in the amounts of these gases in the atmosphere may cause significant changes in temperature at the earth's surface, with far reaching consequences for mankind.

The chloroflurocarbons are man made gases which are present in the atmosphere, due to human activities. The other gases are normally present in the atmosphere, but there is evidence that man's activities are causing significant increases. Direct measurement of the concentrations of these minor gases in the atmosphere have been possible only in recent years; however, the small gas bubbles trapped in polar ice when it freezes can form a datable record of past atmospheres. Analysis of these ice core samples shows

that for methane the concentration remained fairly constant until about 200-300 years ago when it began to rise (Figure 3). The rate of increase has been greatest in the last century so that present levels are about three times greater than the early records. Similar studies for carbon dioxide show an increase of about 25% with about half of this increase in the last 30 years. These increases are attributed to man's activities, especially in agriculture for the methane and fuel combustion for carbon dioxide.

Increasing the amounts of the "greenhouse' gases in the atmosphere causes more heat to be retained at the earth's surface so that temperatures rise. Direct verification of rising temperatures is not easy; as the daily, seasonal and periodic changes in temperature mask these long term trends unless observations can be extended to cover a lengthy period. The available evidence indicates a general warming trend over the past 30 years (Figure 4).

Current knowledge suggests that the most significant contributions to a warming trend are due to changes in carbon dioxide, water vapour, chloroflurocarbons, methane, and ozone. (Figure 5)

The effects of a continued slow rise in temperature on man's activities could be very significant including:

- increasing summer draught and heat wave conditions in central North America;
- migration of the main climatic zones away from the equator towards higher latitudes;
- rising sea temperatures.

These changes could have significant impact on agriculture and the fisheries.

A global rise in temperatures may also affect rainfall. There is evidence that in the last century the sub-tropical areas (Lat. 5 degrees - 35 degrees) have become drier while the temperate zones (Lat. 35 degrees - 60 degrees) are getting wetter. (Figure 6)

Little is known about the stability of the atmospheric air circulation, the ocean currents or the polar ice caps in conditions of rising global temperatures. More catastrophic possibilities of the greenhouse effect conditions include:

- Melting of polar ice caps causing rising sea level with threatened inundation of many low-lying areas.
- Changes in ocean current patterns such as the Gulf Stream which would affect the climate of western Europe.

Little is known about the long-term stability of global phenomena such as climate, ocean currents and polar ice, through geological evidence suggests that we are still within a period of instability with glacial episodes alternating with milder interglacial conditions.

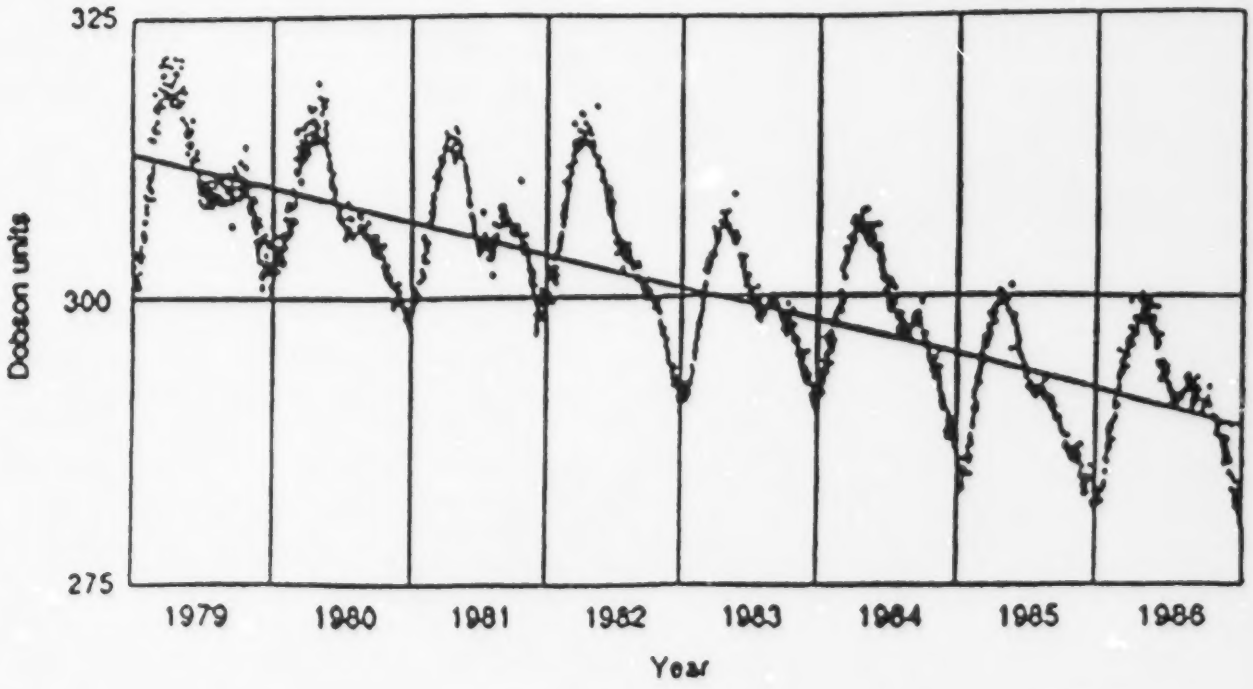
Detailed observations of temperatures at various parts of the earth will need to be extended for a longer period to establish whether the present indications of global warming are part of a long term trend of just a short term cyclic phenomena.

In the meanwhile, it would be desirable to reduce those of man's activities which are tending to change the composition of the atmosphere and increase the greenhouse effect.

From the energy viewpoint, the short term is likely to see a move to a more-efficient use of existing fuels and a corresponding reduction in the rate at which waste gases are discharged. In the longer term, global warming, if continued, could result in increased energy consumption as mankind seeks to compensate for the changes by increased use of air-conditioning, irrigation and other attempts to locally modify climate and conditions.

Figure 1

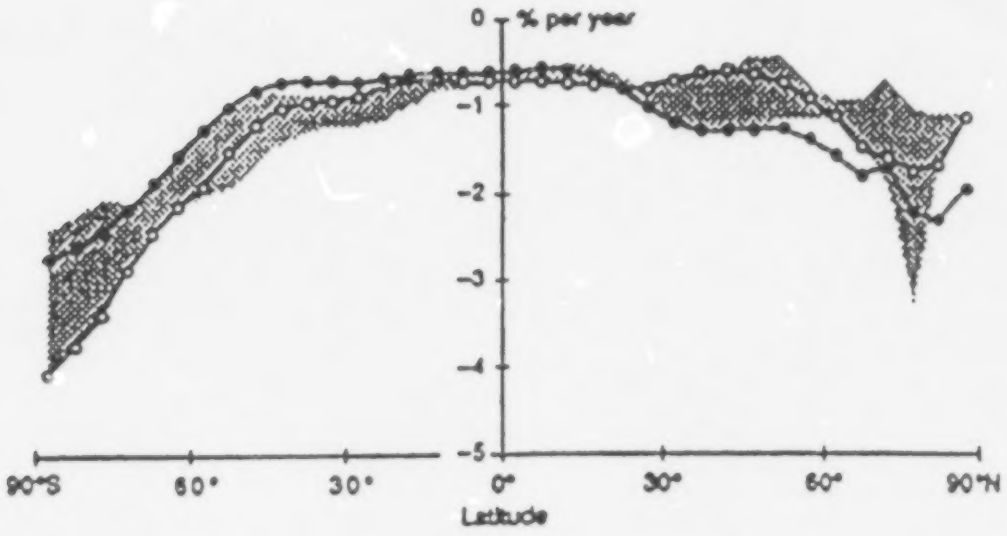
Mean Total Ozone (1 Dobson Unit = 10^{-3} atm cm) for 1979-1986



Source: K.P. Bowman, **Global Trends in Total Ozone Science**, Vol. 239, pg. 48-9, January 1988.

Figure 2

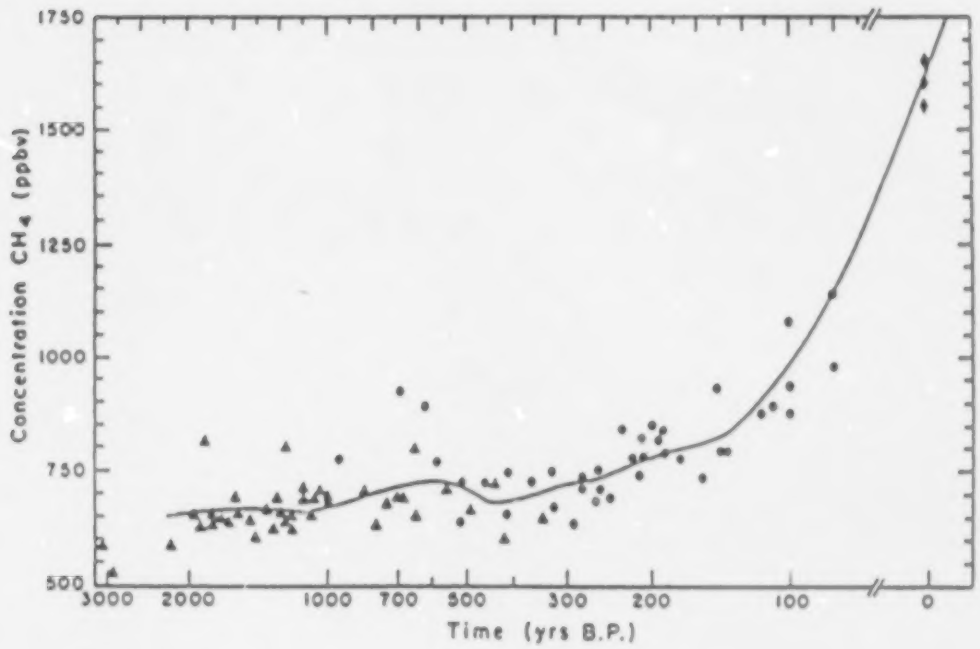
Trends in Zonal Mean Total Ozone for 1979-1986



Source: K.P. Bowman, **Global Trends in Total Ozone Science**, Vol. 239, pg. 48-9, January 1988.

Figure 3

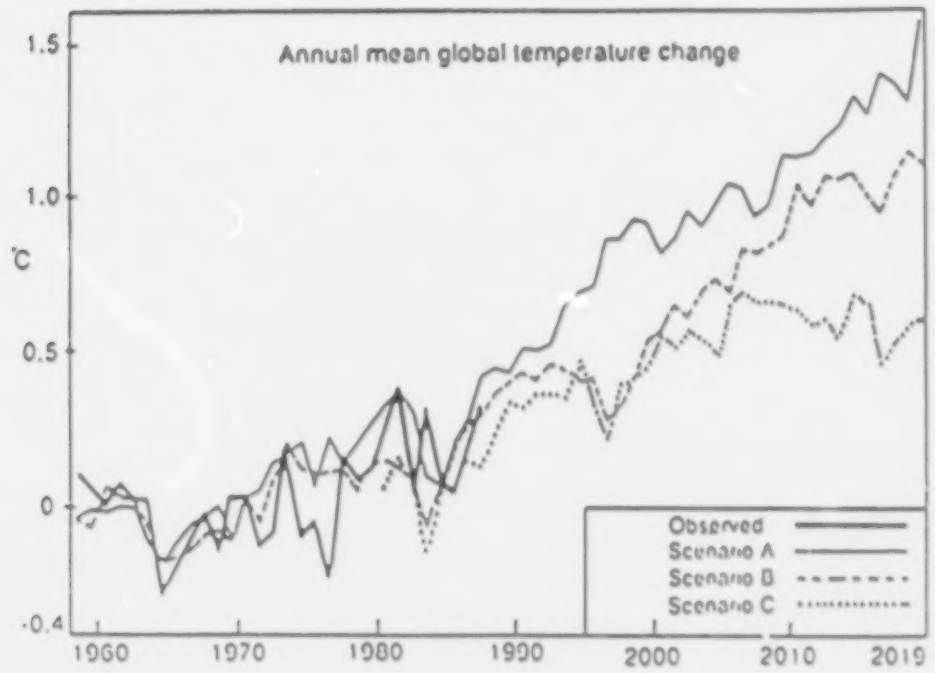
Concentration of Atmospheric Methane (CH_4) with Time



Source: R.A. Kerr, **Doubling of Atmospheric Methane Supported**. Science, Vol. 226, pg. 954-5, November 1986.

Figure 4

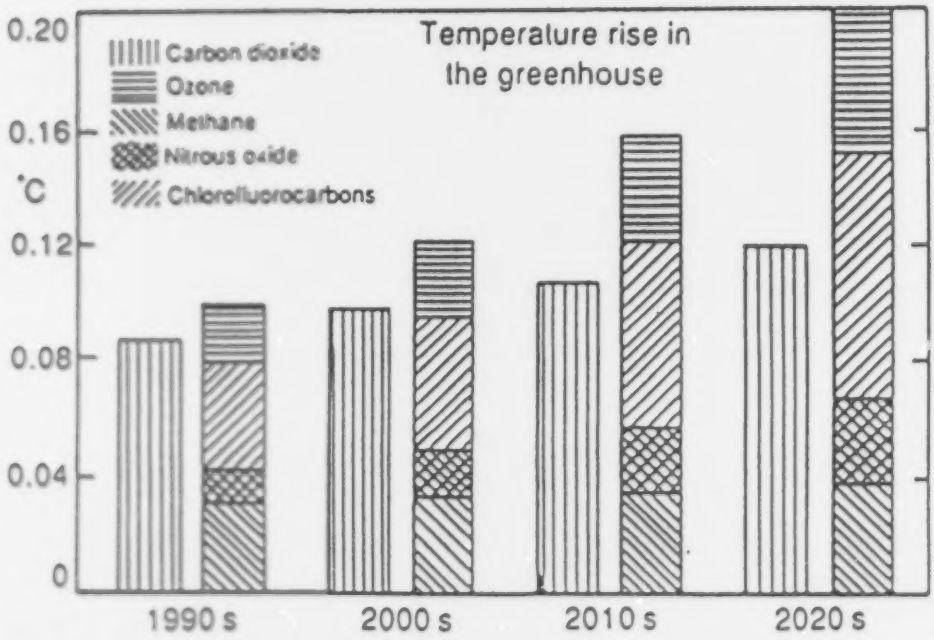
Annual Mean Global Temperature Change Discussed and Predicted



Source: M. McElroy, **The Challenge of Global Change**, New Scientist 119, pg. 34-6, July 1988.

Figure 5

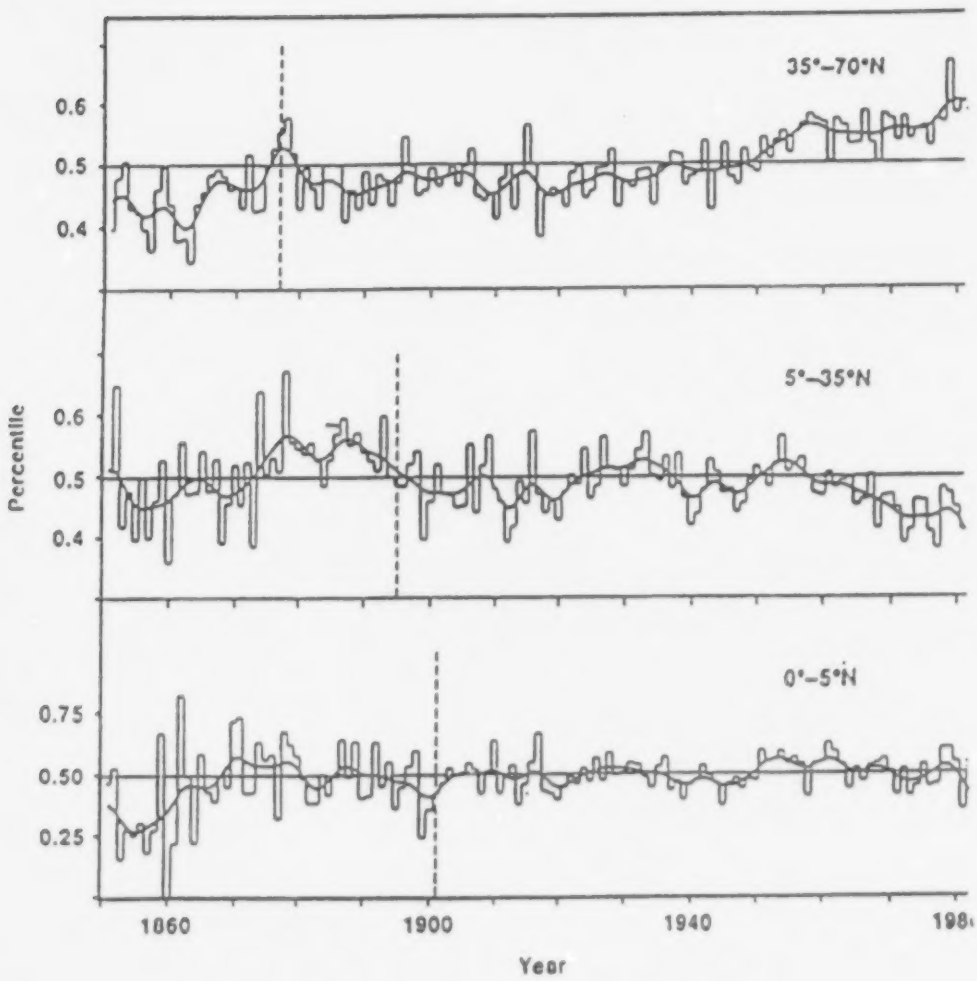
Temperature Rise Due to Various Greenhouse Gases



Source: M. McElroy, **The Challenge of Global Change**, New Scientist 119, pg. 34-6, July 1988.

Figure 6

Rainfall Over Northern Hemisphere Land Areas by Latitude Zones 1850-1980



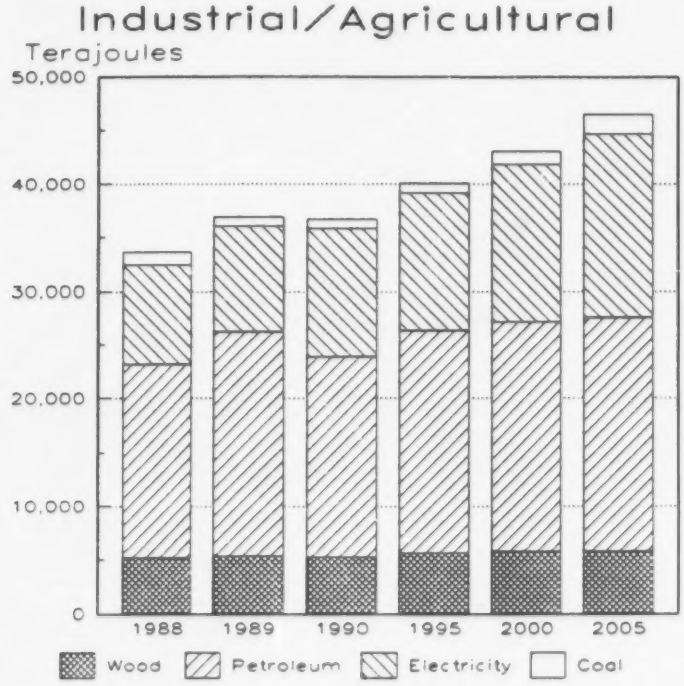
Source: After R. Bradley et al., Science 237, pg. 171, 1987.

Appendix B

Energy Demand Forecast 1988-2005

Economics and Statistics Division
Nova Scotia Department of Mines and Energy
November 1989

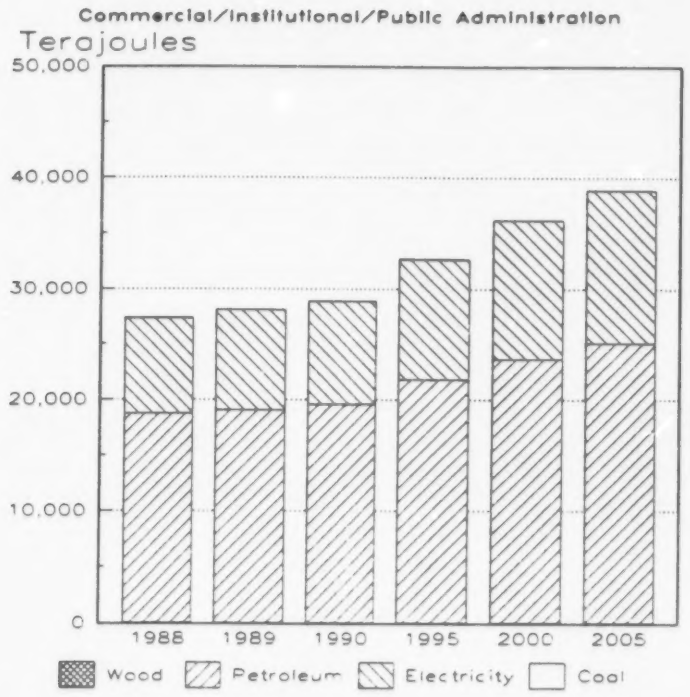
Industrial/Agricultural Sector



Industrial/Agricultural
(Terajoules)

	1988	1989	1990	1995	2000	2005	AA % Chg
Coal	1,200	850	861	900	1,196	1,830	2.5%
Electricity	9,262	9,820	11,962	12,811	14,707	17,218	3.7%
Wood	5,121	5,281	5,198	5,592	5,723	5,752	0.7%
Petroleum	18,026	20,902	18,629	20,724	21,420	21,728	1.1%
Total	33,609	36,853	36,650	40,027	43,046	46,528	1.9%

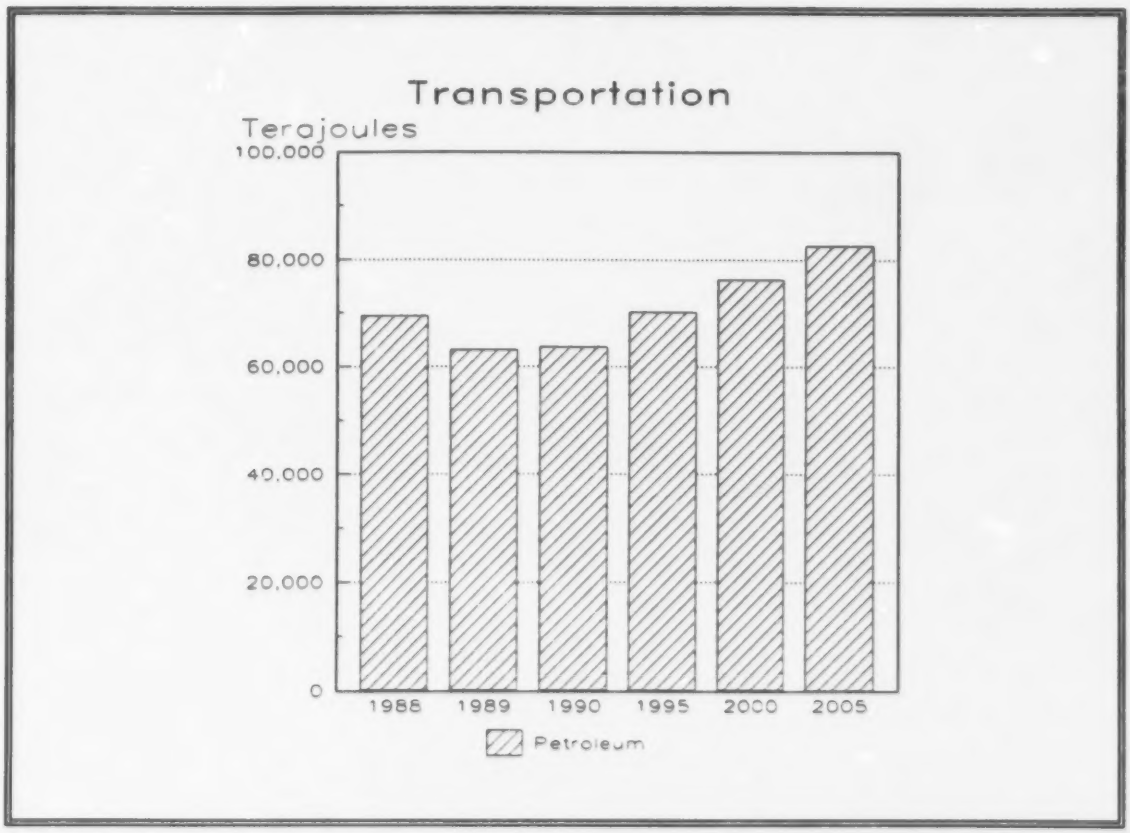
Commercial/Institutional/Public Administration Sector



Commercial/Institutional/Public Administration
(Terajoules)

	1988	1989	1990	1995	2000	2005	AA % Chg
Coal	10	10	10	10	10	10	0.0%
Electricity	8,561	8,984	9,286	10,856	12,521	13,802	2.8%
Wood	35	35	35	35	35	35	0.0%
Petroleum	18,709	19,024	19,528	21,754	23,591	25,020	1.7%
Total	27,315	28,053	28,859	32,655	36,157	38,867	2.1%

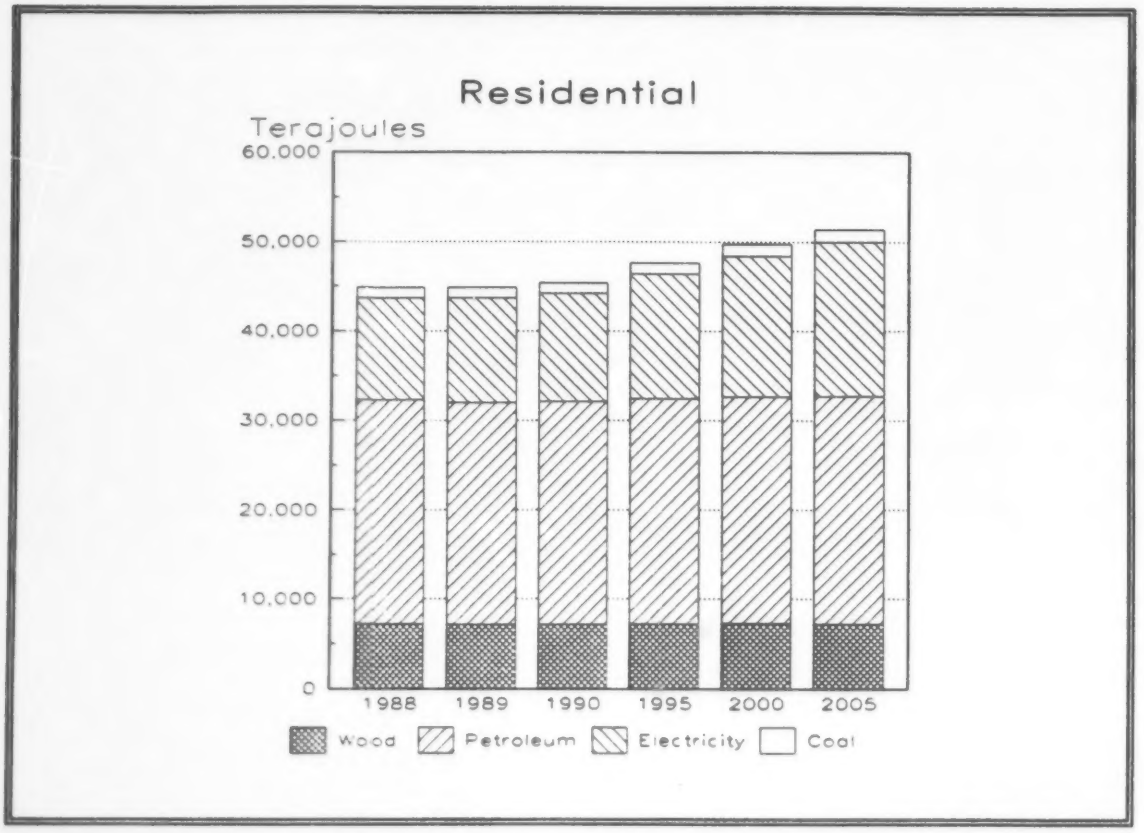
Transportation Sector



Transportation
(Terajoules)

	1988	1989	1990	1995	2000	2005	AA % Chg
Petroleum	69,408	63,004	63,595	70,085	76,252	82,607	1.0%
Total	69,408	63,004	63,595	70,085	76,252	82,607	1.0%

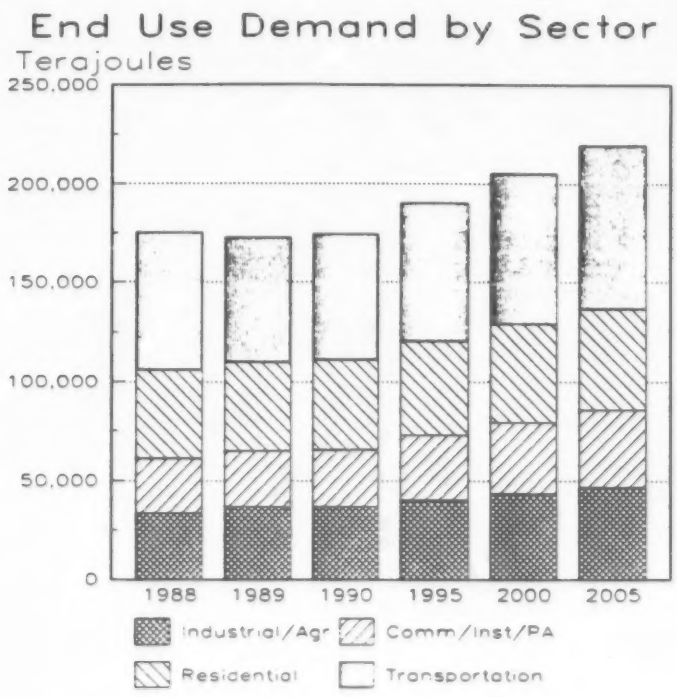
Residential Sector



Residential
(Terajoules)

	1988	1989	1990	1995	2000	2005	AA % Chg
Coal	1,159	1,176	1,194	1,269	1,340	1,397	1.1%
Electricity	11,370	11,651	12,053	13,872	15,712	17,274	2.5%
Wood	7,201	7,115	7,127	7,185	7,236	7,191	0.0%
Petroleum	25,105	24,873	24,968	25,270	25,430	25,515	0.1%
Total	44,835	44,815	45,342	47,596	49,718	51,377	0.8%

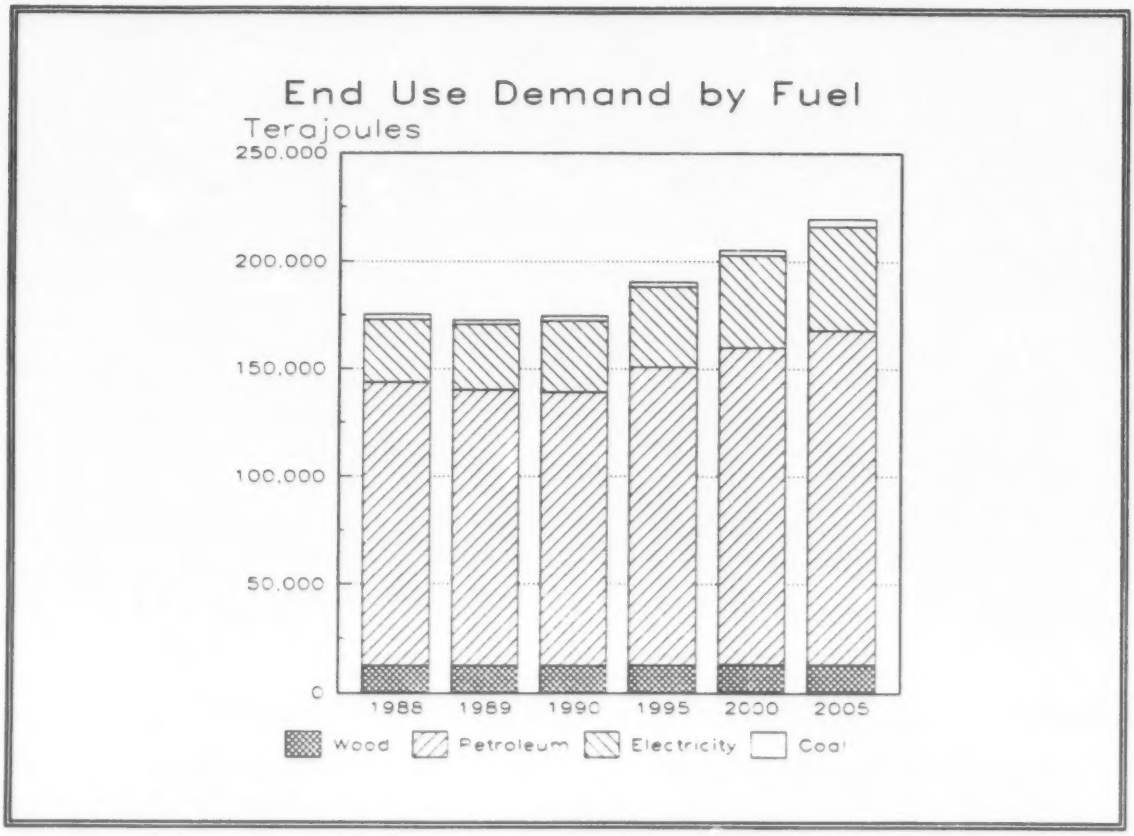
Total End Use Demand by Sector



End Use Demand by Sector
(Terajoules)

	1988	1989	1990	1995	2000	2005	AA % Chg
Industrial/Agricultural	33,609	36,853	36,650	40,027	43,046	46,528	1.9%
Comm/Inst/Public Admin.	27,315	28,053	28,859	32,655	36,157	38,867	2.1%
Transportation	69,408	63,004	63,595	70,085	76,252	82,607	1.0%
Residential	44,835	44,815	45,342	47,596	49,718	51,377	0.8%
Total	175,167	172,725	174,446	190,363	205,173	219,379	1.3%

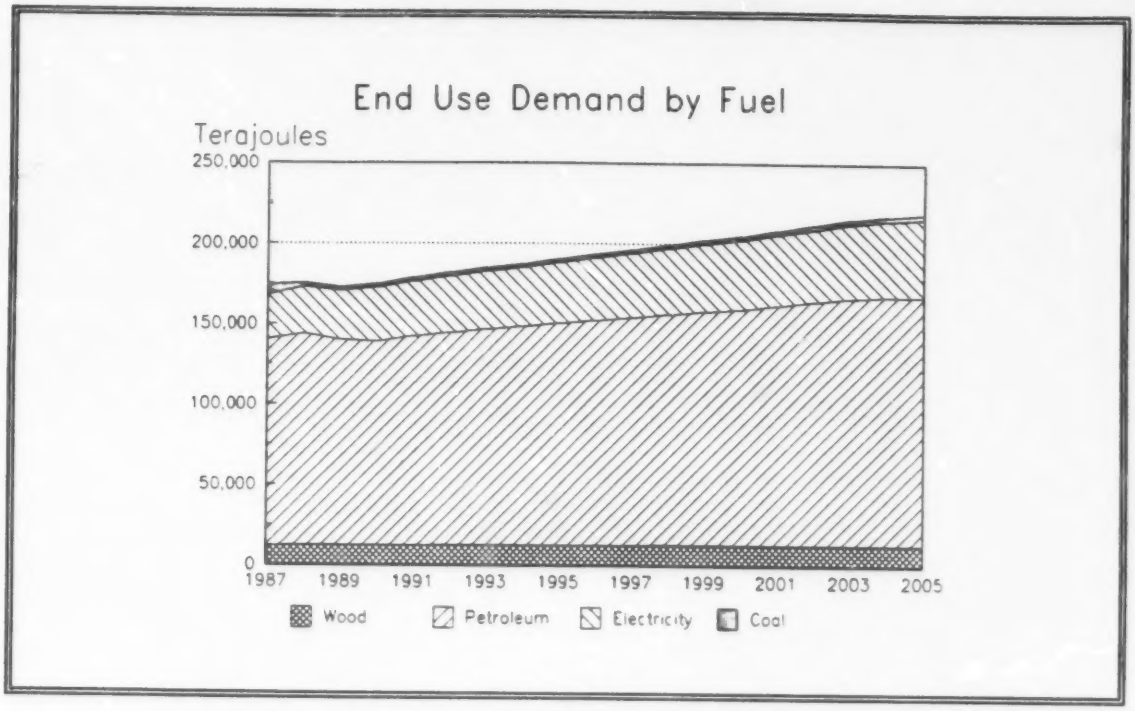
Total End Use Demand by Fuel



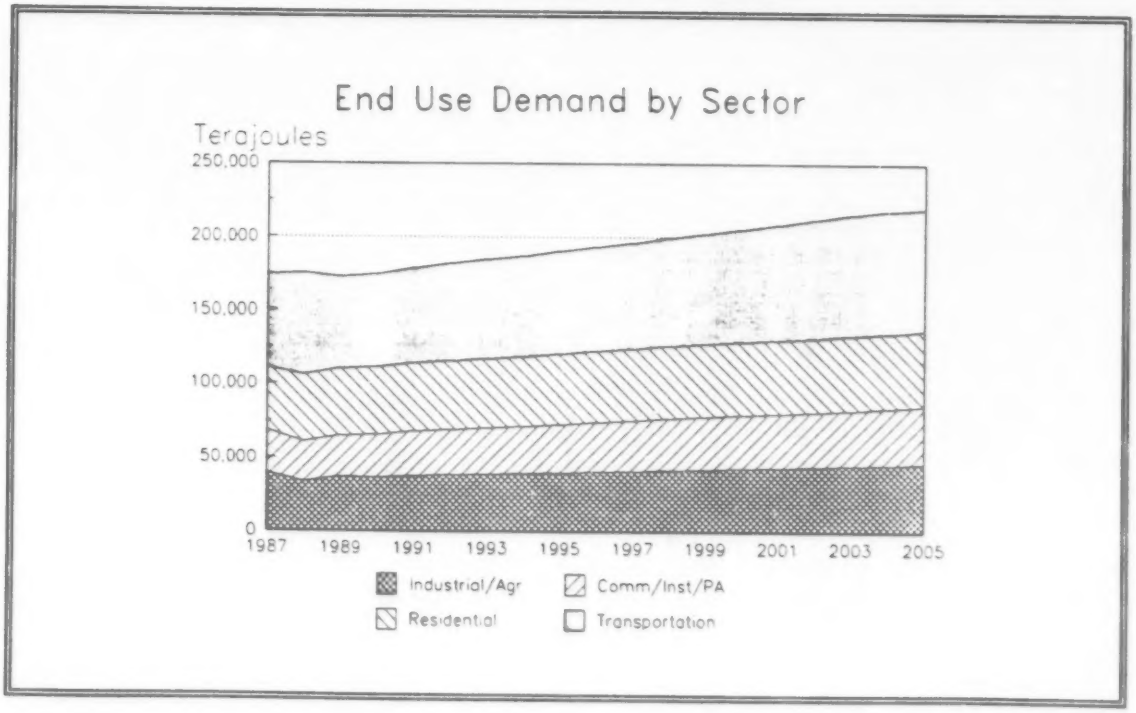
End Use Demand by Fuel
(Terajoules)

	1988	1989	1990	1995	2000	2005	AA % Chg
Coal	2,369	2,036	2,065	2,179	2,546	3,237	1.9%
Electricity	29,193	30,455	33,301	37,539	42,940	48,294	3.0%
Wood	12,357	12,431	12,360	12,812	12,994	12,978	0.3%
Petroleum	131,248	127,803	126,720	137,833	146,693	154,870	1.0%
Total	175,167	172,725	174,446	190,363	205,173	219,379	1.3%

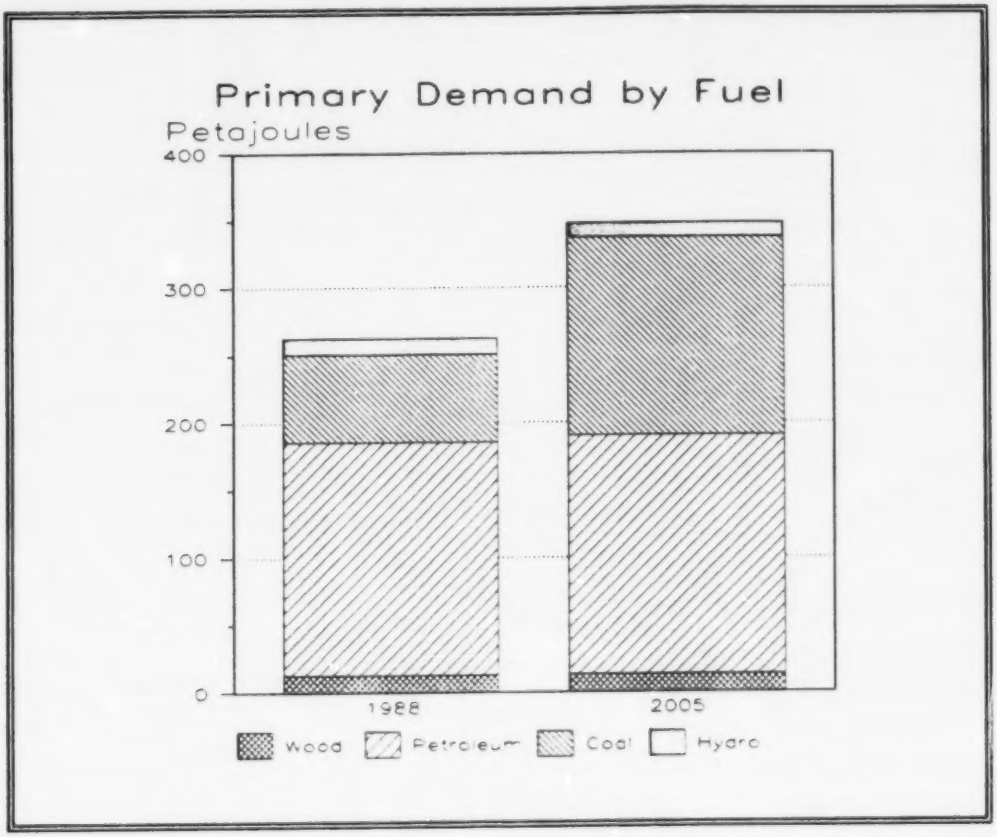
Total End Use Demand by Fuel



Total End Use Demand by Sector



Total Primary Demand by Fuel



Primary Demand by Fuel
(Petajoules)

	1988	% Share	2005	% Share
Hydro	11.9	4.5%	10.7	3.1%
Coal	65.5	24.9%	146.9	42.2%
Petroleum	173.1	65.9%	177.3	51.0%
Wood	12.3	4.7%	13.0	3.7%
Total	262.8	100.0%	347.9	100.0%

Appendix C

Nova Scotia Power Corporation

Nova Scotia Power Corporation

Historical Load and Capacity

Fiscal Ending	Firm Peak MW	Capacity[1] MW	Percent Reserve
1977	1056	1361	29
8	1024	1361	33
9	1098	1561	42
1980	1073	1711	59
1	1125	1857	65
2	1186	1861	57
83	1105	1637	48
4	1237	1789	45
5	1251	1982	58
86	1355	1798	33
7	1361	1798	32
8	1508	1989	32
89	1513	1989	31
90	1627	1989	22

NSPC

PEAK DEMAND FORECAST ACCURACY COMPARISON

(MEAN ABSOLUTE PERCENT ERROR)

1) Forecast Horizon Year	NSPC	2) Canadian Utilities	3) American Utilities
1	3.9	4.3	NA 4)
2	4.0	6.0	5.4
3	3.4	7.3	NA
4	3.3	9.4	11.6
5	6.2	11.9	NA
6	6.0	12.7	19.2
7	10.9	15.7	NA

1. Forecasts from 1978 to 1984
2. CEA Survey, March 1985 (Excluding NSPC)
3. Battelle Survey, August 1985
4. NA - Not Document in Battelle Survey

NSPC

FUEL COST, $/MILLION BTU'S

Fiscal Ending	Coal	Oil
1980	1.63	2.15
1981	1.69	2.56
1982	1.70	3.67
1983	1.74	4.35
1984	1.78	5.16
1985	2.34	5.63
1986	2.55	5.70
1987	2.67	2.99
1988	2.80	3.32
1989	2.90	2.43

Utility	Fuel as a % of Total Revenue - 1987
Nfld. & Labrador Hydro	18
Nfld. Light & Power	-
Maritime Electric	-
Nova Scotia Power	39
New Brunswick Power	20
Hydro Quebec	-
Ontario Hydro	21
Manitoba Hydro	-
Saskatchewan Power	29
Alberta Utilities	8
British Columbia Hydro	13

NSPC

CAPITAL COST OF PLANT

$/KW

	$/kW	1)
LINGAN 1 (1979)	730	2)
LINGAN 2 (1980)	420	
LINGAN 3 (1983)	850	3)
LINGAN 4 (1984)	660	
TRENTON 6 (1991)	1600	
POINT ACONI 1 (1993)	1820	4)

1. Current dollars.
2. Lingan 1 included facilities common to Lingan 2.
3. Lingan 3 included facilities common to Lingan 4
4. Estimated average cost for three-unit station.

NSPC

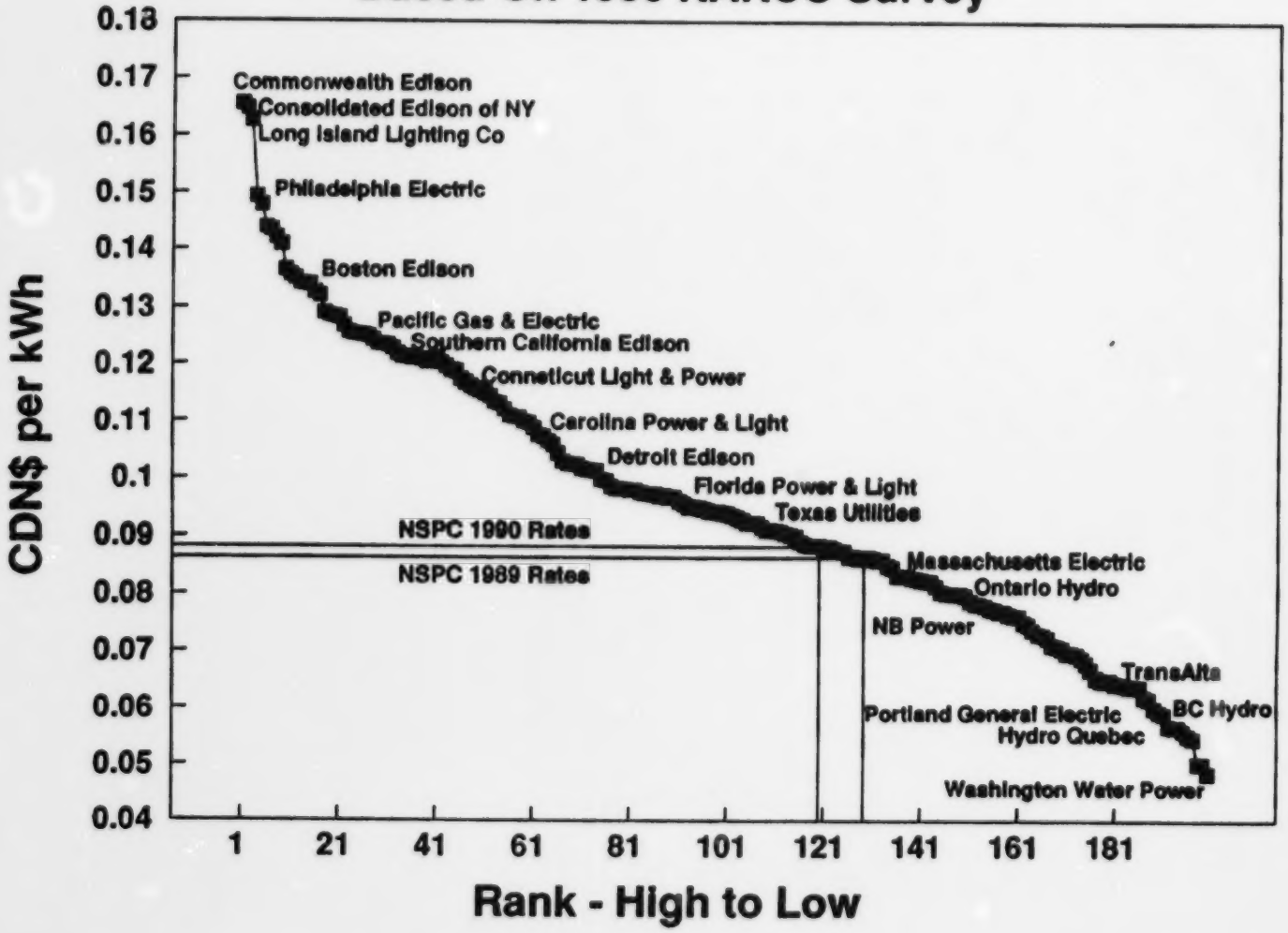
LONG-TERM DEBT

(MILLION $)

FISCAL ENDING	LONG-TERM DEBT
1980	958
1981	982
1982	1056
1983	1232
1984	1388
1985	1469
1986	1481
1987	1591
1988	1681
1989	1814

1989 N. American Utility Rates

Based On 1990 NARUC Survey



POWER SMART

The Nova Scotia Power Corporation (NSPC) has, following ten years of load research and experimentation, commenced a program of demand side management initiatives with an objective to achieve a reduction in demand of approximately 150 MW by the year 2000.

NSPC will develop and deliver these programs under the title of Power Smart, originally developed by B.C. Hydro, in conjunction with other utilities across Canada. Energy saving initiatives will initially be encouraged by making information available to customers and ensuring the availability of energy efficient products in Nova Scotia at fair prices through the development of trade allies. Subsequent programs may require incentives and rebates to obtain a reasonable penetration.

Early programs will involve low flow shower heads, water heater blankets, improving home efficiency and energy efficient lights in homes and commercial and industrial premises. These will be followed by energy efficient motors, variable speed drives and new home design and construction. NSPC is also working to improve the efficiency of its in-house use of energy in buildings and for street lights and through waste heat recovery from power plant cooling water. Initial response and public interest and ally support has been encouraging but modification to Building Codes may be necessary to realize the full potential for energy efficiency in new homes.

Appendix D

Recommendations
Report of the Select Committee on Forestry

REPORT OF THE SELECT COMMITTEE ON FORESTRY WOODCHIP AND BIOMASS HOUSE OF ASSEMBLY, NOVA SCOTIA, MAY 1987

Recommendations

Based on presentations received, visits made and our deliberations, the Select Committee recommends the Province of Nova Scotia adopt as policy the following recommendations:

1. Establish a management committee from provincial departments to coordinate the implementation of government activities in the use of energy from wood fibre combustion, with a chairman representing the Department of Mines and Energy.

2. Establish a program of support for feasibility studies of wood fuel substitution where preliminary analysis indicates favourable opportunity for conversion.

3. Provide funding assistance for the demonstration of wood energy technology where appropriate to encourage conversion or initial installation.

4. Investigate the potential for district heating systems in Nova Scotia and their impact on the use of wood fuel energy, employing appropriate demonstration sites.

5. Encourage the conversion of government owned or supported facilities where wood fuel substitution is cost effective.

6. Undertake chipper demonstration trials, in conjunction with the private sector and woodlot owners, under a range of stand conditions and equipment configurations to help determine harvest productivity and operating costs.

7. The government and private sector should, together with the Commissioner of Forest Enhancement, encourage, promote and monitor the use of forest fibre to ensure the highest utilization of forest fibre in Nova Scotia and the enhancement of the forest.

8. Avoid large scale (above 10 MW) electrical generation from wood fuel but encourage co-generation where favourable economics exist.

9. Designate a wood energy specialist attached to the Department of Mines and Energy, to be available for advice, pre-feasibility analysis, coordination of user/supplier contacts, and to provide a source of technical information.

10. Provide information and advice on request to potential suppliers of wood chip markets through existing marketing specialists in the government department of Lands and Forests.

11. Encourage the Government of Canada to continue the accelerated tax write off provisions for wood fuel use or to enhance this measure with other forms of appropriate incentives.

12. We recommend in conclusion that due recognition be given to the demonstrated economic advantages of forest management, job creation, and spin-off benefits to Nova Scotia.

Appendix E

Conversion Factors

Conversion Factors[1]

Metric	Imperial Equivalent Units
1 cubic metre of oil (15°C and 922 kg/m^3) (15°C and 855 kg/m^3) (15°C and 739 kg/m^3)	= 6.292 26 barrels (60°F and 22° API) = 6.292 58 barrels (60°F and 34° API) = 6.294 03 barrels (equilibrium pressure, 60°F and 60° API)
1 cubic metre of natural gas (101.325 kilopascals and 15°C)	= 35.30101 cubic feet (14.73 psia and 60°F)
1 cubic metre of ethane (equilibrium pressure and 15°C)	= 6.330 barrels of ethane (equilibrium pressure and 60°F) = 9.930 thousand cubic feet of ethane gas (14.73 psia and 60°F)
1 cubic metre of propane (equilibrium pressure and 15°C)	= 6.3000 barrels of propane (equilibrium pressure and 60°F)
1 cubic metre of butanes (equilibrium pressure and 15°C)	= 6.2968 barrels of butanes (equilibrium pressure and 60°F)
1 tonne	= 1.102311 tons
1 kilojoule	= 0.9482133 British thermal units (Btu)
1 gigajoule (GJ)	= approximately 0.95 million Btu, or 0.95 thousand cubic feet of natural gas at 1000 Btu/cf
1 petajoule (PJ)	= approximately 0.95 billion cubic feet of natural gas, or 165000 barrels of oil or 0.28 terawatt hours of electricity

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[1] Canadian Energy Supply and Demand 1985-2005; National Energy Board, October, 1986, p. 129-130

Gross Energy Content Factors

Natural Gas Approx 35.0 MJ/m^3
(Avg. for B.C./Alberta)

Ethane (liquid)	18.36 GJ/m^3
Propane (liquid)	25.53 GJ/m^3
Butanes (liquid)	28.62 GJ/m^3
Crude Oil	
Light and Medium	38.51 GJ/m^3
Heavy	40.90 GJ/m^3
Pentanes Plus	35.17 GJ/m^3
Coal	
Bituminous	29.30 GJ/tonne
Sub-bituminous	19.76 GJ/tonne
Lignite	15.35 GJ/tonne
Average domestic use	24.00 GJ/tonne

Petroleum Products

Aviation Gasoline	33.52 GJ/m^3
Motor Gasoline	34.66 GJ/m^3
Petrochemical Feedstocks	35.17 GJ/m^3
Naphtha Specialties	35.17 GJ/m^3
Aviation Turbo	35.93 GJ/m^3
Kerosene	37.68 GJ/m^3
Diesel	38.68 GJ/m^3
Light Fuel Oil	38.68 GJ/m^3
Lubes and Greases	39.16 GJ/m^3
Heavy Fuel Oil	41.73 GJ/m^3
Still Gas	41.73 GJ/m^3
Asphalt	44.46 GJ/m^3
Petroleum Coke	42.38 GJ/m^3
Other Products	39.82 GJ/m^3

Electricity

Secondary	3.6MJ/kW.h
Primary - Hydro	3.6MJ/kW.h
Nuclear	12.1MJ/kW.h

Appendix F

List of References

LIST OF REFERENCES

The following is a list of reference material used in the development of this report.

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